

The Mining Journal

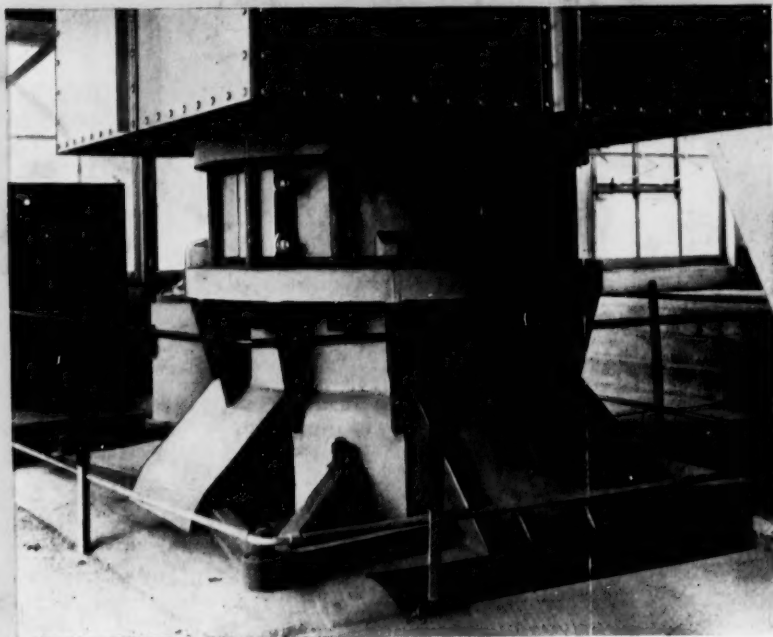
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LONDON, SEPTEMBER 16, 1955

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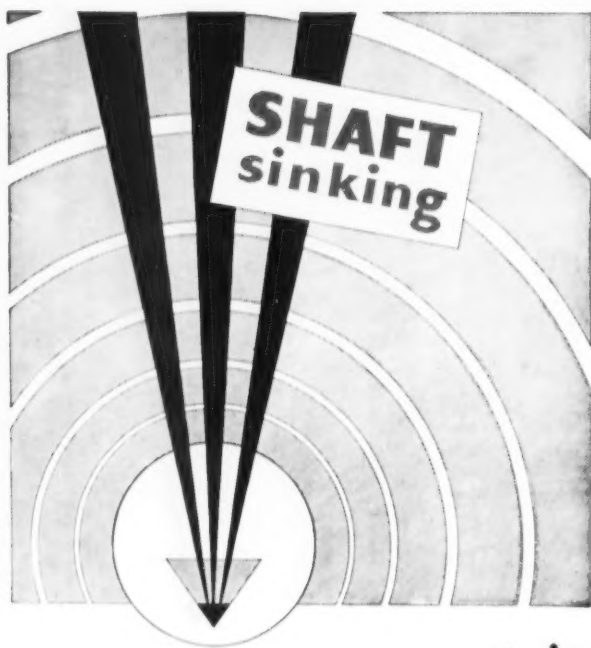
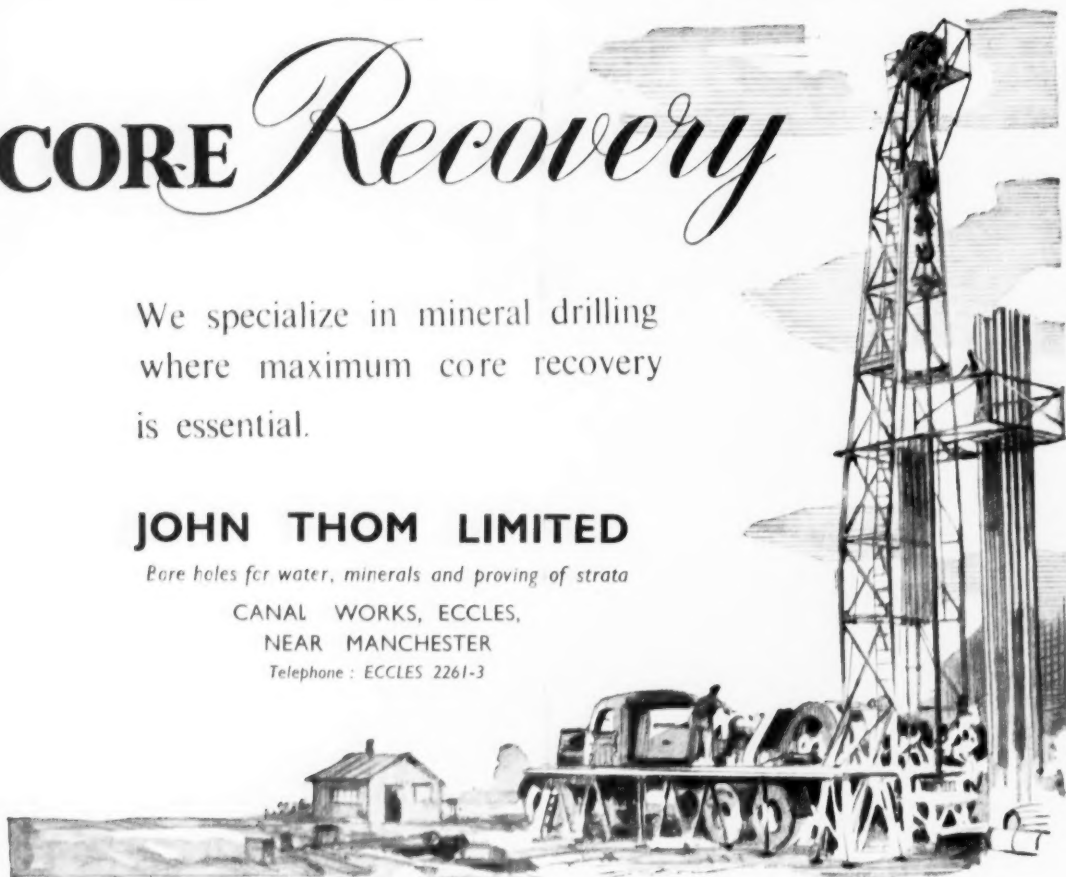
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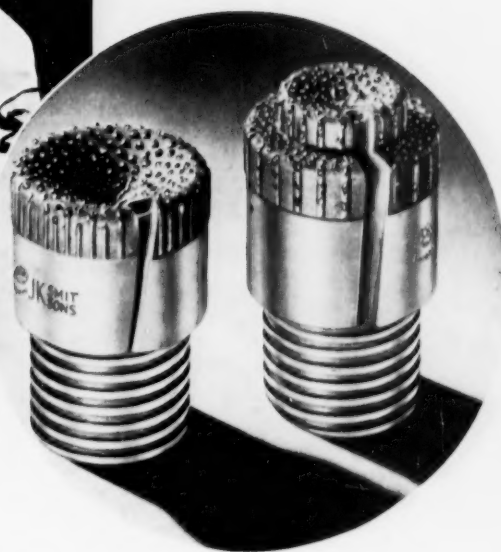
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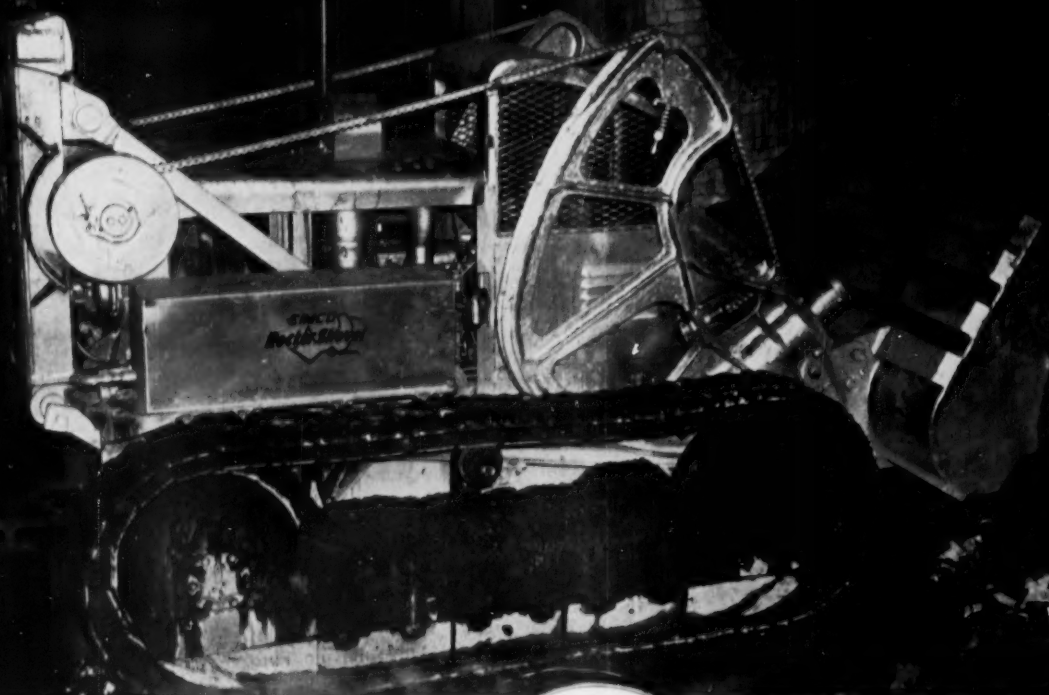
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ATLAS COPCO EQUIPMENT POURS INTO TURKEY TO DEVELOP CHROME ORE MINING INDUSTRY

Turkey during the last few years has become the world's main producer of metallurgical grade chrome ore. Though it has been mined and exported from there for over 90 years, it wasn't until recently that it was produced in any

quantity. The reason for neglect was Turkey's high transportation costs. Consequently, the only deposits developed were those near the coast or indeed any place where transport was easy enough to allow a decent profit.



The location of Turkey's chrome ore mining areas. The majority of the mines employ Atlas Copco compressors and Atlas Copco light rock drills fitted with Sandvik Coromant tungsten-carbide-tipped drill steels.



A repair shop on wheels! This fully self-contained vehicle belonging to Atlas Copco Ticaret ve Sanayi T.A.S., tours chrome ore mining areas servicing Atlas Copco equipment and Sandvik Coromant drill steels.

CHROME EXPORTS RISE RAPIDLY

In 1950 came the Korean War and everything changed. The price of chrome in world markets soared. Mining the ore in out-of-the-way regions at last became a paying proposition and small mines were opened up in large numbers. These export figures supplied by the Turkish Chrome Committee indicate the increased development of metallurgical grade chrome ore during the past seven years:

	METRIC TONS
1948	100.000
1949	146.627
1950	200.000
1951	330.000
1952	462.532
1953	492.777
1954 (Jan.-Aug.)	239,031

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mines and the working of new ones. The Atlas Copco company in Turkey, Atlas Copco Ticaret ve Sanayi T.A.S., supplied this equipment. Latest figures of Atlas Copco equipment now being used in the industry are given at over one hundred stationary and portable compressors and about three hundred light rock drills. These are fitted with Sandvik Coromant tungsten-carbide-tipped drill steels—the world's most widely used integral drill steels.

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An Atlas Copco rock drill fitted with a Sandvik Coromant drill steel at work. The drill is one of three hundred supplied by Atlas Copco to the Turkish chrome ore mining industry since 1951.



An Atlas Copco P-8/600 centrifugal sump pump being placed in position. Many of these pumps are among the wide range of Atlas Copco equipment sent to Turkey.

* Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment

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The Mining Journal

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NOTES AND COMMENTS

Progress on the Copperbelt

The announcement from the Copperbelt last week-end of agreement between R.S.T. and the European mine-workers on the initial stage in African advancement provide further evidence of the new spirit of co-operation in which the union is now approaching this problem. It is to be hoped that both this and the Anglo American agreement (see *M.J.* August 5, page 151) will prove to be decisive steps towards the eventual complete solution of the colour-bar problem, which has so long been plaguing Copperbelt labour relations and upon the solution of which the future of Central African Federation so much depends.

The present agreements represent, of course, only a first move in this direction, although the 24 job categories agreed on are a not unreasonable compromise between the 31 categories sought in the earlier Chamber of Mines negotiations and the 13 "ragged edge" categories originally offered by the union, and which it would probably have been glad to be quit of in any case. For the Copperbelt as a whole these 24 categories represent, together with the creation of certain African jobs not previously performed by Europeans, a total of about 1,200 new African jobs which will involve the transfer of about 250 Europeans to other work.

In practically all respects the R.S.T. agreement parallels that of Anglo American. This is hardly surprising as R.S.T. participated in the negotiations which led up to the Anglo American agreement, and indeed it seems probable that six weeks ago agreement might have been reached on a Chamber of Mines basis had it not been for R.S.T.'s determination not to concede the right of veto which the Anglo American companies embodied in a letter to the union accompanying their agreements. These veto assurances (which R.S.T. have persistently refused to give on the ground that to do so would be to place the industrial future of the industry permanently in the hands of one union) amount to an undertaking that Anglo American will at no time in the future seek to implement any measure of African advancement without the agreement of the European unions concerned.

Having obtained this concession from Anglo American it at first sight appears somewhat surprising that the union

should have consented to reach agreement with R.S.T. without the veto assurance. It may well be, however, that the firm stand, which R.S.T. has taken all along in its dealings with the European union, may have convinced the latter that to stress the veto issue would have eventually forced them into strike action at a time when the level of the copper bonus (which has lately been running at above 100 per cent) would make this an exceptionally costly sacrifice for its members. Aside from any such consideration, the union must see clearly enough that, with or without the veto, it is in effect in a position to block any future measures of advancement to which it may be resolutely opposed and, incidentally, that strike action over this issue, should it become necessary at some time in the future, might well come at a time when the price of copper is at a more normal level.

Lord Malvern, the Federal Prime Minister, emphasized the realities of this situation when he observed in the Assembly on August 9 that "the bone of contention over consultation in the future is purely academic, because we, who have lived out here all these years, know that if there is any advancement against the goodwill of the European union, then it is bound to be a failure. The union has agreed to this advance, and there can be no further advance, whether in the agreement or not, without the goodwill of the Europeans." In point of fact the union has in connection with the R.S.T. agreement indicated that it has no intention of unreasonably withholding its consent to future African advancement and this, coupled with the absence of the veto provision, seems, for what it is worth, to take much of the sting out of the Anglo American concession, since it is hardly conceivable that at some future stage in negotiations the Union would be ready to grant more favourable conditions of African advancement to R.S.T. than it would to Anglo American.

The Anglo American veto is admittedly a one-sided concession, by which it in effect denies itself the freedom if necessary to pursue the question of African advancement through the normal machinery of collective bargaining while leaving the union full freedom of action. It is thus probably unprecedented in the history of British industrial relations. At the same time it is nevertheless entirely consistent with the view taken throughout these

negotiations by Anglo American that advancement can only be achieved by carrying the European unions willingly with the companies at every stage. Such an attitude implies the belief that in the long run both sides will see the identity of interest which all Europeans have in the peaceful and positive evolution of the status of the African. As Sir Ernest Oppenheimer observed at the time of the Anglo American agreement, "once the process [of advancement] has actually begun, much of the present rigidity will go out of the situation and it will tend to develop in a natural and healthy manner. . . . The best thing to do is to head out in the right direction and allow patience, goodwill and tolerance to play their part in shaping the future."

For the moment the essential thing is that both agreements should now be made to work as expeditiously and painlessly as possible. Much will depend on the determination and promptitude with which both the companies and the union give effect to the Africanization of the initial 24 categories and in this respect we welcome this week's announcement that Africans have already been selected and will shortly commence training for these categories at the Anglo American mines. So far the Africans have been largely on the side lines in these recent advancement negotiations; now they must be made to feel and appreciate the realities of the "partnership ideal".

Both agreements are provisional in the sense that they cover only a three-year period and no doubt both groups will be anxious to supersede these agreements by a Chamber of Mines agreement as soon as there is sufficient identity of viewpoint to make this practicable. In the meantime the fact that the Anglo American agreement provides that discussion on further advancement may occur at any time *after* the three-year period, while the R.S.T. agreement provides that such discussion may take place as soon as the detail job analysis has been completed, is unlikely in practice to prove much of an embarrassment as one imagines it may well take the best part of two years for the analysis to be completed and for the recommendations to be digested by the interested parties.

Mr. R. A. Butler Exports Confidence

Mr. R. A. Butler's speech to the International Monetary Fund in Istanbul on Wednesday was a weighty contribution to this country's exports. The material offered, fashioned so carefully, found a world wide market and although the trade mark bore the label "Made in England—beware of substitutes" the admonishing suffix was warranted.

Mr. Butler went to Istanbul not to throw another pebble into the international economic arena (the backwash from his last missile, convertibility, has not yet subsided), but to pull sterling round by stating as categorically as he could that Britain was still on the right road to economic recovery. For that to be fully justified speed was not the most important thing. Patience, a more generous U.S. trade policy and, above all, confidence were far more vital and lasting factors in the equation.

For those in this country the import of Mr. Butler's speech lay in its comprehensive grasp of the many points about the direction of the economy on which doubts had recently arisen.

For the first time the Chancellor openly denied the Government's intention to widen the margins of the sterling dollar exchange rate. This assurance, albeit overdue, should do much to halt the speculative selling of pounds. His recently initiated policy aptly termed the credit squeeze was, he said, proving satisfactory, and although inflation was still with us this fear was world wide. To meet this problem the U.K. Government were examining the whole

field of public expenditure with a view to limiting the demands on labour and resources and it would take whatever steps were necessary to make the goods available to satisfy export requirements.

The Chancellor rejected the negative measures of physical controls and import restrictions as prescriptions for the hoped-for prosperity. The problem, as he saw it, was to bring into balance the supply and demand for labour and materials. Subsequent Government policy would be directed to achieve this end. With regard to the sterling area, he thought that the fundamental position was sound. Exports had increased and although the trading position was still obscured by the effects of recent strikes evidence was piling up to show that a stronger position would soon be reached.

The months ahead would, therefore, be a period of consolidation and no move would be made on the trade or the exchange fronts before the British internal situation had been put right and the balance of payments was in better shape.

The crucial but imponderable factor to assess was the timing for any new move on either front. At present with world conditions still largely dominated by the U.S. economy this was certainly not the moment to enter into risks which could not be calculated. Unless and until the United States went much further and faster with their declared policy of facilitating an expansion in world trade, the hopes of the non-dollar world would be blighted. Indeed, even the maintenance and consolidation of their present policies without concrete incentives from the U.S. might be in jeopardy.

South Africa's annual plea for a rise in the dollar price of gold was rejected without qualification by the U.S.A. The well known American objections centering on its inflationary consequences, on its gratuitous advantage to the U.S.S.R. and on its limited direct benefit elsewhere—valid or not—are decisive. The interesting point was, perhaps, that Mr. Butler supported Mr. Louw's proposal with the qualification that a change in the gold price was, more than anything else, a matter of time. That time had not yet arrived and would not so do while governments were struggling to control inflationary pressures on their respective economies.

Portugal

(From Our Own Correspondent)

Foz do Douro, September 9.

At the end of the first half of the current year, the United Kingdom headed the list of importers of Portuguese wolfram ores with 1,159 tonnes. The United States was second with 644 tonnes, followed in turn by Germany 415, Sweden 81, Holland 35 and Austria 10. The export figures for tungsten ores include shipments of residues, as the official figures make no discrimination.

Mineral production during April was (in tonnes): WO₃, 297; cassiterite, 135; scheelite, 21; mixed WO₃/Sn, 68; ilmenite, 67; beryl, 23; lead, 157; mixed Sn/WO₃/Ca, 14; manganese, 410; molybdenum, 1; gold/silver-bearing pyrites, 231; tantalite/columbite, 4; haematite, 11,600; magnetite, 3,526; cupreous pyrites, 55,105; precipitate of copper, 14.

Export figures for June were (in tonnes): WO₃, 387; cassiterite, 8; cupreous pyrites, 30,157; haematite, 10,966; magnetite, 3,450; tin metal, 12,546 (kilos); white arsenic, 40,640 (kilos).

TITANIUM—I

The Australian Beach Sand Industry

By J. A. DUNN and J. W. MORGAN

Since mid-1954, the Australian beach sand industry has shown unprecedented activity. Under the stimulus of rising prices and demand, production of rutile and zircon has greatly increased—last year the production of rutile concentrates reached the all-time record of 44,658 tons—while a further strong influence is the demand for rutile for the production of titanium metal. The following article is condensed from a paper entitled *Titanium and the Australian Beach Sand Industry*, appearing in *The Australian Mineral Industry Quarterly Review*, Vol. 8, No. 1. The first portion of the article, appearing herewith, describes the uses and production of titanium, while a subsequent instalment will discuss resources and the significance of titanium to Australian rutile producers. Dr. Dunn is chief mineral economist, Bureau of Mineral Resources, Geology and Geophysics, Australian Department of National Development.

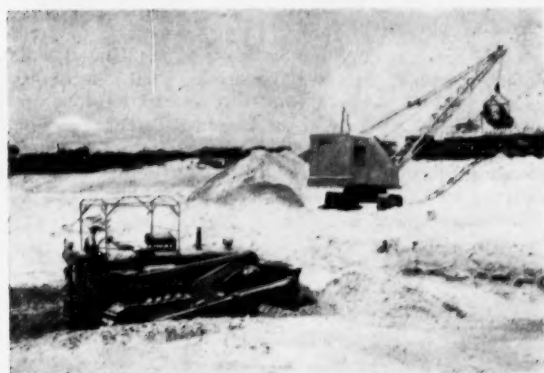
This change from the somewhat depressed position of the Australian beach sand industry in 1953 is partly explained by the general recovery of world manufacturing industry from the slight recession of 1953. However, another strong influence is now being felt, namely the demand for rutile for the production of titanium metal. Within recent months there have been rapid developments in titanium metal production from an experimental to a commercial operation. Rutile (a titanium dioxide) had been the principal basic raw material in the experimental work on metal reduction, and for the present continues to be the basic raw material for commercial production of titanium.

WIDENING SCOPE OF TITANIUM

Titanium is a relatively light metal, intermediate in weight between aluminium and stainless steel, with exceptional mechanical properties up to 800 deg. F. and a high resistance to corrosion. These properties have opened up fields of application of titanium and titanium base alloys where minimum weight and high strength are desirable. To date, high cost and inconsistent quality have limited the demand for titanium. Of the total consumption, about 90 per cent has been for aircraft frames and engines.

Delay in the commercial supply of titanium has been due to the metallurgical difficulties in obtaining a sufficiently pure metal from its ore. These difficulties arise from the extreme readiness with which titanium absorbs oxygen, nitrogen, carbon and hydrogen, resulting in a loss of ductility and toughness. These problems of metal production have now been largely solved, mainly through the research initiated in recent years by the U.S. Government, and latterly by production programmes sponsored by that Government for supply of contracted amounts of metal for defence purposes over the next few years. The way has now been largely cleared for expanding production although fabrication difficulties, yet to be overcome, may restrict its maximum utilization for a while.

The first recorded economic production from the beach



Diesel-driven dragline loading beach sands into an ore train

Production of Concentrates from Beach Sands (tons)

Rutile.		1951	1952	1953	1954
Queensland	...	12,129	13,564	16,124	21,925
New South Wales	...	23,060	24,450	21,915	22,733
Total	...	35,189	38,014	38,039	44,658
Zircon*.					
Queensland	...	10,129	10,540	11,679	13,964
New South Wales	...	32,281	19,151	16,956	27,489
Total	...	42,410	29,691	28,629	41,453

*Containing approximately 2.1% Hafnium

sands of the Australian East Coast was of zircon (zirconium silicate) concentrates at Byron Bay, New South Wales, in 1934, and to stimulate the production of separated concentrates, the Commonwealth Government encouraged the installation of electromagnetic and electrostatic equipment and, in 1944, the export of mixed concentrates was banned, with certain exceptions. Export of mixed concentrates finally ceased in 1949. This policy has since been completely justified.

To-day, the main concentrate exported is of rutile, and it is to the world demand for this mineral that the rate of working of the beach sands is keyed. In producing rutile the contained zircon in the beach sands also passes through the plant; some of this zircon is stockpiled as a rough concentrate for future cleaning and only sufficient clean zircon concentrate is produced as can be economically marketed. To that extent, then, the zircon concentrate is virtually a by-product of rutile production.

The bulk of the ilmenite (oxide of titanium and iron) fraction of the formerly exported mixed rutile-ilmenite-zircon concentrate is nowadays dumped. The relatively high chromium oxide content of the ilmenite concentrate from the East Coast renders it unacceptable, without further uneconomic treatment, for the production of titanium pigment, the principal outlet for ilmenite on world markets.

Small amounts of the following minerals also are present in the beach sands: monazite, garnet and cassiterite, and traces of gold and platinum. With the exception of monazite, these are of no economic significance. Of the monazite available some is recovered and marketed for eventual treatment for its thorium, cerium and other rare earths content.

USES AND WORLD DEMAND

The annual consumption of rutile and zircon in Australia is estimated at 2,000 tons and 1,100 tons respectively. The prosperity of the industry is thus determined by overseas demand.

The principal use of rutile to date has been in the coating of welding rods, in the manufacture of titanium carbides, alloys, and in ceramic mixtures such as porcelain enamels. The major uses of zircon are in the ceramic and refractory fields, but small amounts are also required in the production

of ferro-alloys for use in steel manufacture. Over recent years world capacity to produce these minerals had reached the stage where it covered the quantities required for the above purposes. By 1952 there was, in fact, a decided over-production of zircon, whilst in 1953 the demand for rutile had fallen concomitantly with the recession in general world industry.

Prices reacted accordingly. For a while, between 1949 and 1951, Australian producers themselves, with the assistance of the Minister for Trade and Customs, endeavoured to maintain export prices but, with improved demand in 1951, the necessity of this disappeared and in 1951-52 rutile rose to £60 a ton and zircon to £15 a ton. In 1953 rutile fell to £30 a ton, and zircon to £10-12 a ton, port of shipment. With improved recent demand, open market prices have now risen to over £70 a ton for rutile, and to £12-13 a ton for zircon.

On the other hand, production of titanium metal had by 1954 passed the experimental stage. The construction of plants for titanium metal production is leading to a greatly increased demand for rutile from Australia. World annual production of rutile and zircon is at present roughly in line with demand. In 1954, world production of zircon was 72,000 tons, and of rutile about 52,000 tons.

Another titanium mineral which may be of interest in metal production is ilmenite (oxide of iron and titanium). World production in 1954 was about 1,000,000 tons, almost all of which was used for the production of titanium oxide pigment.

TITANIUM METAL PRODUCTION

Several methods for the production of titanium metal are under investigation, but only one, the Kroll process, has advanced to the stage of commercial production. If any other methods supersede the Kroll process, it will be on the basis either of some advantage in cost or in the use of labour. We may, therefore, examine the likely future development of the Kroll process with this understanding.

Under the Kroll process, the production and processing of titanium metal is divided into three stages. The first stage is the production of titanium tetrachloride from the raw materials. Chlorine reacts on a mixture of titanium ore and carbon at a temperature of 800-1,000 deg. C., to form mixed gases from which is obtained a condensate of titanium tetrachloride, and ferric chloride and other impurities. The titanium tetrachloride is recovered by distillation and subjected to further purification.

It is thus apparent that a titanium raw material containing iron and other impurities, means the absorption of excess chlorine, and possibly the subsequent treatment of the chlorides derived from these impurities for the recovery of chlorine. For the present, therefore, rutile, the purest of the titanium raw materials, is preferred.

The stage of tetrachloride production is of such a nature that it can be a continuous and fully automatic process, and may represent less than 25 per cent of the eventual cost of sponge metal.

The second stage is the reduction of titanium tetrachloride to sponge metal. Liquid titanium tetrachloride is reduced by molten magnesium under an inert atmosphere

of either helium or argon. Magnesium chloride is drawn off, and titanium sponge accumulates in the reactor. The metal sponge is finally either bored out, chiselled out, or dumped out.

This reduction is a batch process, and so far as can be foreseen will remain such; it requires high labour and capital cost, and for this reason is the most costly part of metal production. The maximum size of a batch to date is 3,000 lb.

Entrapped magnesium and magnesium chloride in the sponge is removed either by leaching, or by distillation in a vacuum retort.

The third stage is the production of titanium ingots and fabrication. Sponge and re-melt scrap are pressed together into rectangular sections, several of which are welded to form one large electrode. This is suspended in a sealed water-cooled copper crucible through which argon is passed, or maintained under vacuum. After striking the arc, the electrode metal collects on the bottom of the crucible, that on the walls of the crucible being cooled instantly to solid metal.

The surface of the ingot is cleaned by being turned on a lathe, then forged to the size and rough shape required for fabrication of mill products.

At present each of the above stages from the raw material to the mill product is carried out by separate plants or organizations. Thus Company A supplies the tetrachloride to Company B, which may market titanium sponge to Company C. If the industry is to expand and costs are to be reduced, it will be only a matter of time before these stages are integrated into a single organization. Such an integrated plant will, for example, permit a great saving by the installation of equipment for the recovery of magnesium metal and chlorine by electrolysis, thus requiring only the purchase of make-up magnesium and chlorine.

CURRENT DEVELOPMENTS

A large amount of research on other processes has been and is being undertaken. In particular the use of sodium instead of magnesium in the Kroll process has reached the commercial stage. Electrolytic processes are in the pilot plant stage. It is almost certain that new processes will be developed which are an improvement on the present Kroll process.

At present titanium sponge metal is being produced in the United States, the United Kingdom, Japan and Germany, and pilot plants are in operation in Canada. The largest plant at present in the United States has a capacity of 3,200 tons metal annually. So far as can be ascertained sponge metal production in 1954 was: United States 4,730 tons, Japan 444 tons, United Kingdom and Germany pilot plant production.

Under present development plans in the United States, annual capacity there will be around 30,000 tons metal sponge by 1957. A new plan to produce 1,500 tons came into operation this year in the United Kingdom. Japanese production is also expanding. Taking into account developments in Canada and Germany, production of between 35,000 and 40,000 tons a year is likely by 1957.

Exports of Rutile (tons)

Destination	1952	1953	1954
U.S.A.	18,392	13,416	14,418
U.K.	9,072	8,662	9,891
Netherlands	1,458	3,129	4,634
Fed. Rep. Germany	1,032	1,914	3,926
France	2,738	1,880	3,439
Italy	894	1,769	2,044

Destination	1952	1953	1954
Sweden	1,657	2,521	1,555
Belgium	640	465	1,356
Japan	93	3,128	1,223
Others	1,678	292	1,931
Total	37,654	36,076	44,417

Stoping Steep Reefs at Depth at Durban Roodepoort Deep

Despite the fact that a system of underhand longwall mining had been successful at depth on other Witwatersrand gold mines, the steep reef at the Durban Roodepoort Deep mine provided certain adverse conditions which made it advisable to return to the previous local practice of underhand stoping below 4,700 ft. depth. The new method devised, termed "wall shrinkage" stoping, is described in the following article by G. H. Duggan, manager of Durban Roodepoort Deep Ltd. The article is condensed from a paper entitled, *A Method of Stopping Steep Reefs at Depth*, presented before the Centenary Congress of the Société de l'Industrie Minérale in Paris during June, 1955.

The reef on the Durban Roodepoort Deep is steep. For this reason it was worked overhand. When the workings became deeper (below 4,700 ft. from surface) it was thought advisable to change the method to a system of underhand longwall mining which had been used successfully at depth elsewhere on the Witwatersrand.

The reasons for the adoption of this method were: To reduce the number of remnants to a minimum and thereby to lessen the likelihood of pressure bursts; to reduce the danger to personnel from face-bursting or slabbing; to reduce the number of accidents caused by slipping or falling; to enable permanent support to be built closer to the working face; and to reduce the contamination of waste walls with gold bearing sludge. The overhand method then in vogue was such that it was possible for water from the stope face to trickle through panels of broken reef in swept areas carrying with it gold bearing sludge.

RETURN TO OVERHAND STOPING

After some 18 months experience working underhand faces, it was decided to abandon this method and to return to overhand stoping for the following reasons:

The dangerous conditions of the hanging in the mined out areas, in spite of more than 50 per cent waste wall support built as close as practicable to the face; face bursting was found to be excessive, and accidents from this cause were more in the underhand stopes than in those worked overhand; despite barricades, contamination of waste walls with reef from the blast was found to occur, and the method was expensive in timber and labour.

Other reasons were that the breaking efficiency, as compared with overhand stoping, was of a very low order. All holes were drilled down dip and it would appear that the force of gravity reduces the amount of rock broken by such holes. If more than one machine were used on a face, there was always a delay in starting a second or third machine because all broken rock had to pass down the face. The difficulty of persuading European rock-breakers to work in these places.

The overhand method adapted in place of the longwall underhand was a form of semi-shrinkage which, to differentiate it from other such methods, was termed "walled shrinkage".

The aim is to work overhand longwall faces from one main haulage level to the next. The levels are at vertical intervals of 200 ft. and the haulages at intervals of four or five levels. The raise connections are spaced as far apart as major faults and dykes or other mining contingencies permit, to a maximum of about 2,000 ft. It is obvious that development of drives must be at least four levels ahead of stoping to make this method practicable.

The faces are mined at an apparent dip of 32½ deg. and are kept as straight as pos-

sible. Every effort is made to keep the longwall in line over successive levels, but this is not always possible. However, it has been found that serious difficulties are not encountered provided the advance or lag of a face, compared with the one below it, is less than 100 ft.

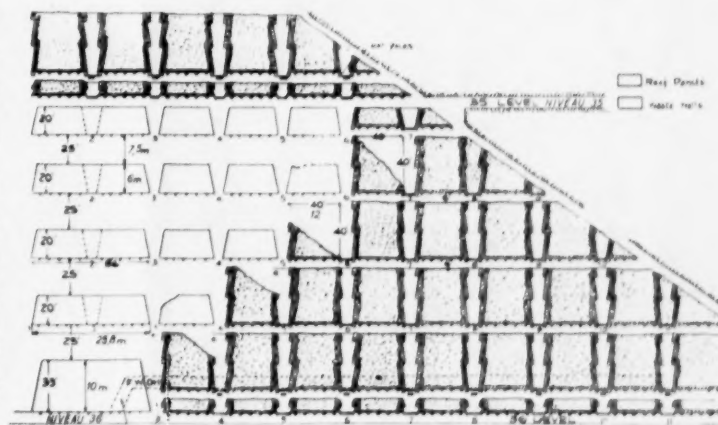
METHODS OF SUPPORT

The primary support consists of reef shrinkage which is walled in 40 ft. by 40 ft. panels, and which should be a uniform distance of 6 ft. from the face. If too much broken rock is removed drilling is delayed, because sprags then become necessary; if insufficient is removed partial blockage of the face may interfere with drilling.

The reef panels are built to standard dimensions. A stull, 40 ft. wide on strike and from 5 to 10 ft. on dip, is built in the stope immediately above the drive to act as a cover to it. Where the stope footwall shows signs of breaking away, "knee-action" supports are used. When the width of the reef approaches 60 in. much of the drive footwall is removed when the stope below it is mined. To support such a drive, until it is displaced by the footwall drive for tramming, rail ring supports have been found to be satisfactory. These are lightweight (20 lb. per yd.) rail rings made to 7 ft. dia. and placed at 3 ft. 9 in. centres. They are pegged to the hanging-wall and are backed by 8 ft. x 3 in. poles with rock interlaced between them.

Above the drive support a 6 ft. wide strike opening is left. Overlying this strike break are the 40 ft. by 40 ft. reef panels with 6 ft. wide strike breaks between them. The panels are supported by stulls made of 8 ft. x 2 in. lagging. The stulls are supported by mat-packs (slabbed timber skeleton packs either 2 ft. x 2 ft. or 2 ft. 8 in. x 2 ft. 8 in. sq., depending on the stoping width) on each side of each ore pass, and by props spaced about 5 ft. apart between the mat-packs.

The sides of the panels are walled to a depth of about 3 ft. and are laid back 1 ft. on strike for every 4 ft. on dip



Plan of typical overhand stope face where all reef is mined on the face

They are sloped one in four from footwall to hanging. Thus funnel-shaped passes are left between panels. These passes are 4 ft. wide at the bottom and 14 ft. wide 20 ft. up. At 20 ft. they are narrowed down to 4 ft. again by the erection of stulls supported on mat-packs, thus forming the saw-teeth of the ore passes which will stand up to the battering of the broken rock which passes down them. They have proved very effective. A control is provided for every ore pass at each strike break (i.e. at 46 ft. interval on dip).

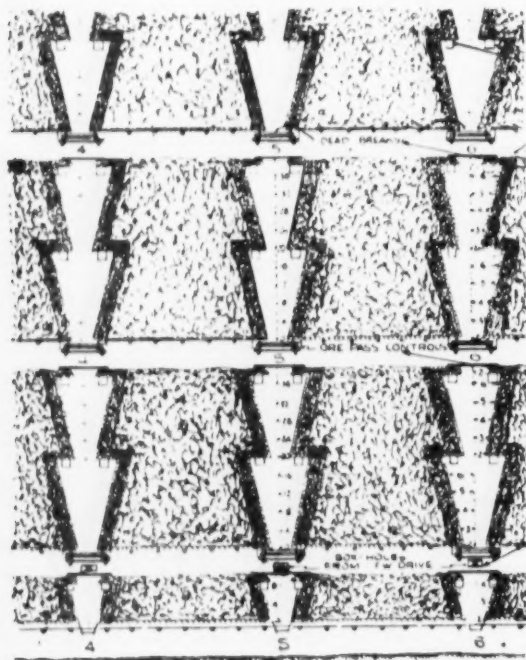
The top section of each ore pass is kept full of broken rock to facilitate travelling along the face. Sufficient rock is bled from these sections daily to allow room for the next blast. These full passes not only make travelling up and down the face safer and easier, but also protect the ore pass walls from the blast and provide a measure of control over large rocks, most of which can be used for extension of the walls.

Normally stope faces are not allowed to exceed a width of 60 in. from hanging to footwall. It has been found that where widths are greater than 60 in. face slabbing dangerous to personnel is liable to occur. When the reef width is more than 60 in. the policy is to mine the zone of best value first, because a measure of selective mining can be practised when the residual band or bands are reclaimed.

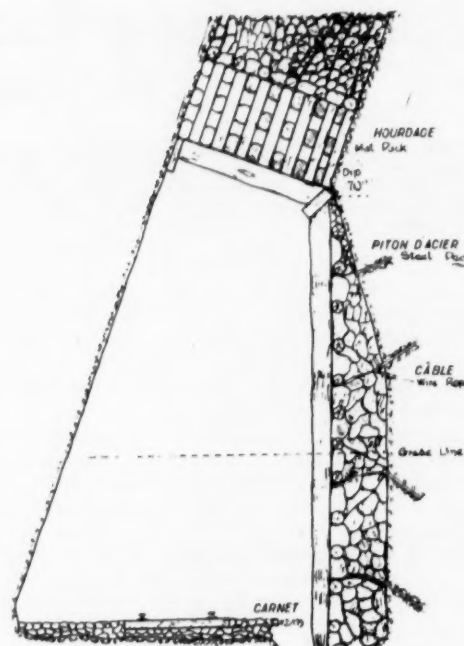
OTHER EXTRACTION PRACTICES

The extraction of reef panels and the reclamation of residual bands or reef is started from the top of a stope as soon as the top panel adjacent to the face is sufficiently built to provide a screen from the face blast.

When there are other bands of reef to be reclaimed these are mined concurrently with the removal of the reef panels. They are worked underhand at an apparent dip of about $32\frac{1}{2}$ deg. in a direction away from the stope face. This reclamation face is mined so that the rockdrill operator is able to stand on the face while drilling. A very small charge of explosive is used in the holes to minimize scatter and to prevent shattering interbedded waste rock bands.



Plan showing details of reef panels, ore passes, footwall drive and boxholes



Knee action support in reef drives

Walls built of waste rock are built to provide the permanent support, and at least 50 per cent of the area mined is walled. Waste rock for the permanent walls is obtained from various sources, namely sorting in the stopes, hanging wall or footwall gullies as near as practicable to where the waste is required, development by the rescue method where the reef width is narrow, and development in waste rock such as shaft sinking or for the purpose of establishing haulages or ore passes.

Other supplies are obtained from sorting at reef tips, sorting in that reef development which is not reused, or from quarries. These quarries may be either reef or waste, the waste quarries being mining dykes or waste faces where the reef has been displaced by faulting, and reef quarries being workings in which the value is below the limit of payability, and in which the reef band itself is narrow but of relatively high value. Such faces are sometimes mined and the broken product passed through sorting stations.

Because of the steepness of the reef it has been found necessary to develop footwall drives. These are positioned on the same horizon as the reef drives and about 20 ft. in the footwall and from them box holes are raised.

CONCLUSIONS

In conclusion, Walled Shrinkage stoping provides good hanging wall control, little danger from rolling stones on a face or slipping or falling at the face. Further, little or no lashing is required, few face props are necessary and a relatively high breaking efficiency is obtained. Drilling operations are facilitated and there is little possibility of contaminating waste walls and swept areas with reef or gold bearing sludge.

The disadvantages of the method are that it provides a very large lock up of broken reef, the creation of remnants is unavoidable, and the stope ore passes are liable to hang up owing to their steepness. It is necessary for development to be at least four levels ahead of stoping.

Central Cleaning Plant at Lynemouth Colliery

By H. Y. ROBINSON, M.Sc., M.I.M.E., A.R.I.C.S.

The large reorganization scheme undertaken by the National Coal Board is nearing completion at Lynemouth Colliery in the northern area of the Northumberland coalfield where, owing to the depletion of past workings, the major portion of future production must be won from inferior seams. Under the existing conditions intense mechanization is necessary for economic exploitation, demanding in turn a large measure of elasticity in the choice of methods of mining. To permit this freedom of decision the N.C.B. has installed a large central cleaning plant at Lynemouth Colliery, so that by mechanical cleaning of the entire output a saleable product is ensured whatever the quality of the mined coal. The following article, describing the Lynemouth central cleaning plant, is condensed from *King's College Mining Bulletin*, Vol. 8, No. 2, and the author is senior lecturer in mining at The University School of Mines, King's College, Newcastle upon Tyne. Acknowledgments are also due to the Mitchell Engineering Group for their assistance in the preparation of this article.

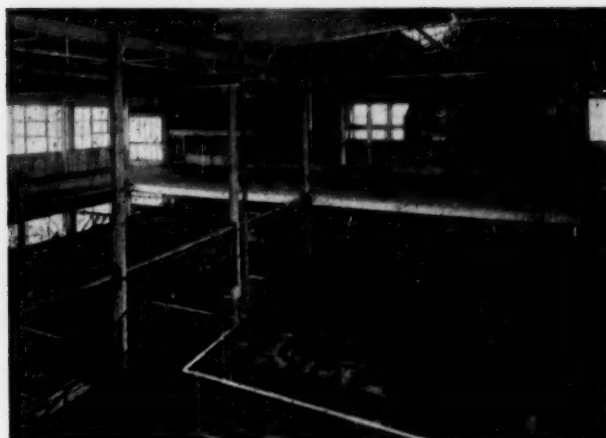
The coal to be treated at the Lynemouth central cleaning plant comprises the outputs of the enlarged and deepened Lynemouth shafts, which also include the production from workings of the adjacent Newbiggin Colliery which is to be closed, and also the wagon-borne production from Ellington Colliery. These outputs consist of several seams of varying character which demand a considerable degree of flexibility in the cleaning system to ensure that uniform qualities can be produced over a long period despite changing mining conditions.

The new plant has been operating for nine months, and has a capacity of 800 tons per hour. It is the largest preparation plant in operation in Great Britain. When the underground developments are completed the plant will treat nearly 12,000 tons per day, 8,000 tons from the Lynemouth shafts and nearly 4,000 tons from Ellington.

The plant is a three process unit incorporating Ridley-Scholes Heavy Medium Separators, Acco Baum Jigs and Unifloc Froth Flotation. A central raw coal bunker receives by belt conveyors the Lynemouth coal directly from the shafts and the Ellington coal from track hoppers and from this point onwards the plant is in two duplicate sections each designed to handle 400 tons per hour.

HEAVY MEDIUM SECTION

Twin raw coal conveyors feed the run of mine coal past tramp iron separators on to two 8 in. scalping screens from which the small amount of oversize is passed to a hand picking belt. The undersize is divided between four high-speed screens which separate at $1\frac{1}{2}$ in. The -8 in. $+1\frac{1}{2}$ in. fractions are fed to four Ridley-Scholes primary baths while the $-1\frac{1}{2}$ in. fractions pass into surge bunkers of a total capacity of 200 tons.



Ridley-Scholes primary baths



Banks of primary cells

It is interesting to note that the Ridley-Scholes coal washing system, a British invention, has been further developed and the type of bath used in the Lynemouth installation is an improvement on the prototype. Important features are the shallow bath, the paddles which assist the movement of the clean coal along the surface of the separating medium to the point of discharge over a weir into a transverse trough, and the positive drive for the endless belt.

THE PRIMARY BATHS

The primary baths operate at a S.G. of 1.40 using a more or less stable suspension of magnetite. This is achieved by grinding to less than 200 mesh, stabilizing the suspension with clay and using gently inclined upward currents. The clean coal floats, even up to 8 in., clear the overflow weir quite easily and contradict some previous opinions of an upper limit of 6 in. The shale and middlings are extracted by the endless troughed rubber belt.

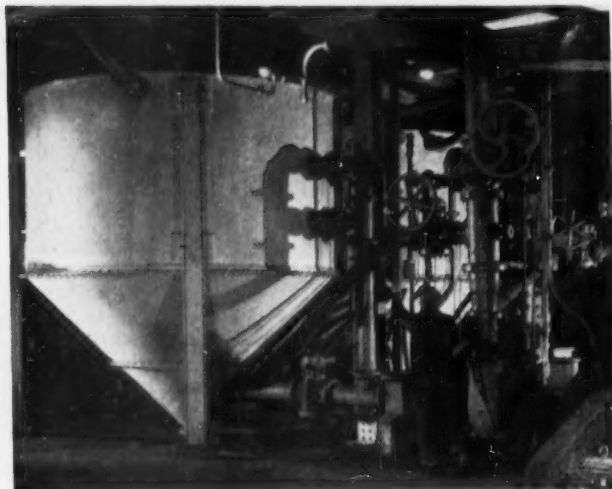
The clean coal floats pass on to upwardly inclined 1 mm. wedge wire drainage screens, one for each bath, from which the medium drains back to the recirculation tanks. On the following spray screens the clean coal is first sprayed with clarified water and then clean make-up water and the dilute medium from the catch trays is passed to the recuperation circuit.

Meanwhile the sinks are passed to drainage screens, one to each pair of primary baths, which feed the shale and middlings to the two secondary baths operating at a S.G. of 1.70. In these the middlings (S.G. 1.40-1.70) are handled in a manner somewhat similar to the floats from the primary baths, while the final sinks are drained, sprayed and passed to the refuse disposal conveyor. Finally the middlings are crushed to $1\frac{1}{2}$ in. by single roll breaker and Flextooth crusher in series, and mixed with

the raw coal feed to the small coal section.

Each of the six heavy medium baths has an independent medium circuit including a surge tank and pumping system. The dilute heavy medium is passed to two thickener systems each of which incorporates three slurry screens. In these circuits the magnetite is reconcentrated by gravity and is extracted from the thickeners by specially designed ball valve mechanisms which are operated by the automatic density controls, these in turn being dependent on constant weighing machines. The overflow from the thickeners is fed to the primary sprays on the spray screens and a bleed is made to the small coal washery to counteract the build up of solids.

New medium is prepared by two ball mills running in closed circuit with rake classifiers which control the grind to -200 mesh. A small hydrocyclone is also fitted in parallel with the classifiers. The heavy medium at a density of 2.0 is held in reserve in a storage tank ready for disposal to any of the medium surge tanks. Linatex rubber-lined pumps are used for handling the medium and a feature of the installation is the inclined flanges which facilitate their withdrawal and replacement.



Surge tank and pumping system

The raw coal smalls ($-1\frac{1}{2}$ in.) from the surge bunkers together with the crushed middlings, are fed to conveyors which elevate them to the top of the building at the opposite end where they are fed to four Acco Baum washboxes of modern design. The four jigs are neatly arranged, with the two outer units discharging shale towards the centre while the two inner reject shale outwards. This arrangement contributes to the general appearance of spaciousness which is a feature of the whole plant. The washboxes are serviced by four main pumps delivering to a large diameter rising main, the rim overflow from which provides constant head to the jig boxes. Normally three pumps are in service with one standby.

The washed coal from the jigs is delivered to four $\frac{1}{2}$ in. sizing screens which pass the $-1\frac{1}{2}$ in. $+\frac{1}{2}$ in. fraction to the centre of the building where it joins the large washed coal from the heavy medium section. From these screens the $-\frac{1}{2}$ in. fraction and wash water pass to four $\frac{1}{2}$ mm. wedge wire dewatering screens which deliver the $-\frac{1}{2}$ in. $+\frac{1}{2}$ mm. washed slack to a collecting conveyor while $-\frac{1}{2}$ mm. material drains off with the water to a reinforced concrete spitzkasten on the ground floor of the building.

The thickened slurry from the spitzkasten is handled by four slurry pumps which deliver to particle-size



Compact arrangement of jigs gives spacious working conditions

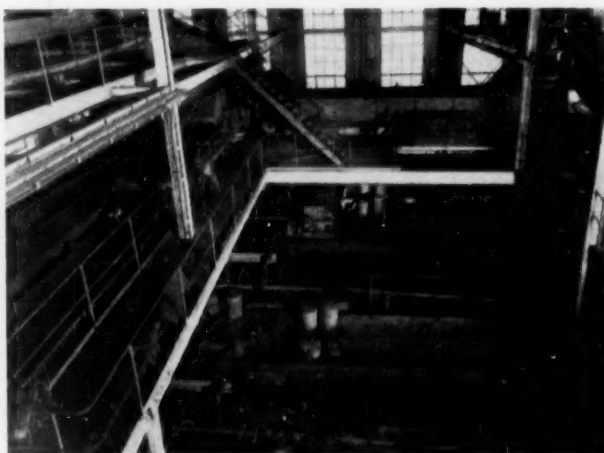
control head boxes and these feed -0.5 mm. coal and water to two conditioners. Form the conditioners the pulp is fed to two 8-cell banks of primary cells and the froth from these gravities to the next floor where it is recleaned in two 6-cell banks of secondary cells. Four string discharge vacuum filters each of 300 sq. ft. filtering area dewater the froth and the filter cake is conveyed to the centre of the building.

The shale tailings pass to a Unifloc clarification plant on the south side of the main building where they are flocculated and thickened in two thickeners of modern design 70 ft. in dia.

The main building housing the Ridley-Scholes plant, the jigs, and the froth flotation section is in the form of a rectangle some 245 ft. long, 105 ft. wide and 70 ft. high.

The clean coal products converging to the centre of this building are conveyed into a wing some 80 ft. sq. and 45 ft. high on the east side of the main building. In this section two banks of screens size the coal at 4 in., 4 in. -2 in., 2 in. $-1\frac{1}{2}$ in. and $1\frac{1}{2}$ in. $-\frac{1}{2}$ in. while the washed slack and filter cake are intimately mixed in a paddle mixer. Belt type boom loaders feed the sized products to wagons on the six tracks under this building.

On the opposite side of the main building provision has been made for the introduction of centrifuges at a later date if required and a bay 80 ft. by 20 ft. has been added. This would comfortably accommodate five centrifuges.

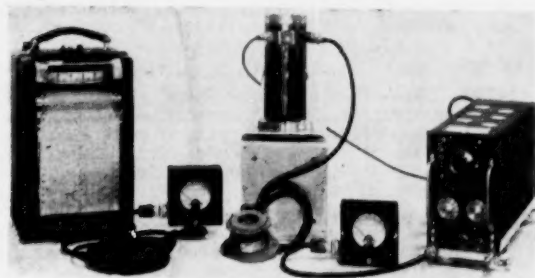


Sizing and loading section

MACHINERY AND EQUIPMENT

Scintillation Detector for Aerial Prospecting

Increased safety in airborne oil and uranium surveys was a key consideration in the design of the Cardinal, a new aerial-mobile scintillation counting system developed by the Radiac Company, United States. It is claimed that optimum efficiency is maintained at altitudes and speeds in excess of those to which conventional aerial counters are restricted.



The Cardinal detector

An automatic alarm circuit signals the pilot whenever an anomaly is passed and enables him to give his full attention to flying. Alarm indication is made by a series of lights flashing on the meter box or by horn if an audible signal is preferred. The Cardinal weighs 17 lb. complete and can be used in a helicopter or other light plane.

The standard Cardinal features a 3 in. by 1½ in. thallium activated sodium iodide crystal and a 3 in. photomultiplier tube as the minimum detection element for airborne work. Three inch and 5 in. crystal assemblies of greater thicknesses are also available and the amplifier-ratemeter unit may be operated with two or more detector-heads to further increase the sensitivity and high count rate. To obtain directional effects and to shield against soft radiation, accessory lead shields can be easily mounted on studs surrounding the detector-head.

Underground Hydraulicking in the United States

American Gilsonite Co., subsidiary of Standard Oil of California and Barber Oil Corporation, is preparing its gilsonite mine in the Uintah Basin in Utah for a unique method of underground operation.

The gilsonite is friable and the vein about 10 ft. thick. A jet of water under a pressure of 2,300 p.s.i. rips the ore from the wall and the ore is caught in a sluice which carries it to a crusher and pump station at the lower level of the 800 ft. shaft. Plus ¼ in. is reduced to that size and the whole pumped to the surface to 30,000 bbl. surge tanks.

From the tanks it is conveyed through an 80-mile pipe line to a coke refiner in Western Colorado. At this plant the ore is dewatered, dried and subjected to further treatment to produce metallurgical grade coke, ammonia and gasoline fractions which will be refined further.

A Range of Rectifier Equipment

The mercury arc rectifiers, manufactured by Hackbridge and Hewitt Electric Co., Ltd., can be supplied in sizes of one or two kilowatts up to any required capacity. This fact is brought out in the manufacturer's publication R.190, which describes the wide range of equipment available.

These rectifiers are for all A.C. or D.C. applications, many of them concerned with the mining industry both in the United Kingdom and in overseas countries. Small equipments of up to 20 or 30 kW. are mounted in cubicles types 40/100 and 100/200, while for higher capacities a type 100/200 E.T. cubicle is used.

This cubicle is designed to stand next to a small oil-cooled transformer.

Rectifier equipments with a single transformer have been constructed up to 8,000 kW. capacity, but where capacities exceed about 3,000 kW. it is customary to employ two or more smaller transformers and connect the complete equipments in parallel.

Protection of Metal Components

The increasing demand for the electro-deposition of nickel and chromium to protect new metal components or build up worn parts was brought sharply into the limelight when a new factory for Fescal Ltd. was opened this week.

The process, which is carried out also at other Fescal plants in the United Kingdom, ensures that non-ferrous metals deposited on new or worn components become an integral part of the basic material. In this cold process no damage is done to high-grade steels. Improved processing is used to deposit chromium direct on to all known light alloys.

New Earth Moving Equipment

Two versions of the Caterpillar D9 tractor (direct drive and torque converter models), announced by the Caterpillar Tractor Company earlier this year, arrived at London Docks last week aboard the s.s. *American Reporter*. The tractors were accompanied by the new 300 h.p. DW21C tractor and scraper.

Claimed to be the biggest tractors in the world, the D9's will be demonstrated for the first time in the United Kingdom at an opencast coal site near Barnsley this month. The D9 tractor weighs 28 tons and has 286 h.p.

A further unit, a 1½ cu. yd. Traxcavator, embodying several new refinements in design, has been added to the Caterpillar range of tractor-shovels. Known as the No. 955 Traxcavator, the tractor and shovel are designed and built integrally by Caterpillar to form one balanced unit. The exclusive oil-type flywheel clutch, fitted to current D6, D7, D8 and D9 crawler tractors and the No. 6 Traxcavator, has also been adopted for the No. 955 Traxcavator.



The D9 tractor being landed in the United Kingdom

One of the outstanding features of this new Traxcavator is a tilt-back characteristic which enables the operator to tilt the bucket through 40 deg. At ground level the push and upward hydraulic thrust can be accompanied simultaneously for better break-out action. The bucket can be alternatively tilted and levelled while pushing to help work its way into material being excavated.

METALS, MINERALS AND ALLOYS

COPPER.—This week's announcement that the U.S. custom smelters are now formally quoting the domestic copper price at 50 c. is no more than formal recognition of a position which has obtained for some time. The announcement is perhaps of more interest as a tacit admission that the L.M.E. price is a lot closer to reality than the U.S. producers' fixed price.

When the American copper industry as a whole comes once more to realize the truth, long obscured by war and post-war controls, that in a free market it is the price of the last ton which establishes the market price, we may perhaps see the U.S. producers allowing their output to be priced at the market. The effect of this would in all probability be to bring about an easement in world prices quite as much as an increase in forward deliveries of Chilean copper to the States.

There is little doubt that, for the moment at least, Britain's less competitive position in her export markets, coupled with the effects of the credit squeeze at home, have taken some of the steam out of the domestic copper demand, a factor which may well have been as important as recent high copper prices in enabling stocks in official warehouses to begin building up again. In this connection it is significant that at least two-thirds of the official warehouse stocks (which now total about 6,000 tons) are thought to be held by metal dealers, only a quite small proportion being earmarked for consumers.

A question of some moment to the London market concerns the Board of Trade's intentions regarding the final stage of its copper stock disposal. It had generally been supposed that some announcement would be made about now regarding the disposal of the remaining 15,000 tons also which, it seemed likely, would be put out to tender for delivery over the period November to March. If the Board of Trade does in fact decide to follow this course, dealers may well have the opportunity of further adding to their trading stocks.

In the States there still appeared to have been some hope at the beginning of this week that the Administration might be persuaded to release copper from the stockpile despite the legislative difficulties involved. However, this prospect seemed less likely on Wednesday when the O.D.M. announced that it had authorized the diversion of 11,000 tons of copper destined for the stockpile during the last quarter of the year. Reports so far to hand do not make it clear whether this figure refers to deliveries which will not become due in the first instance until the fourth quarter, or whether it refers to the 11,000 tons diverted earlier to industry and of which the repayment was until recently due in this period but has since been postponed (see this column September 2). Beyond this the government has also authorized the sale to industry of copper due to be delivered in the fourth quarter under D.P.A. contracts. In the third quarter a similar diversion yielded about 17,000 tons.

Following the recent announcement (see *M.J.*, July 22, p. 100) of the establishment of a new Northern Rhodesian prospecting company—Chartered Exploration Ltd.—sponsored by Anglo American in conjunction with the British South Africa Company and New Consolidated Goldfields, we now have news of a similar initiative undertaken jointly by the R.S.T. and New Consolidated Goldfields whereby a subsidiary of the latter group—the New Consolidated Prospecting Company (Pty.)—will prospect over parts of an area of Northern Rhodesia covered by the grant of exclusive prospecting rights given to Mwinilunga Mines by the B.S.A. Company in 1952. The area is in the north-western province, bounded on the north by the Congo and on the west by Angola and covers about 19,000 sq. miles. These operations, which are to be spread over a four-year period, are in addition to those already being carried out by Mwinilunga. It has often been pointed out in these columns that, whatever the short-term outlook for copper, a long-term expansion in production is inescapable, and it is clear that both groups on the Copperbelt are fully alive to the part which Rhodesia can play in meeting this growing demand, which as emerged so clearly from the Paley Report must come largely from outside the U.S.

LEAD.—The U.S. lead market has remained firm at 15 c. this past week, indeed firm enough for there to have been some talk of the possibility of a price increase. There is, however, reason for thinking that the Administration would not be prepared to support the market by stockpiling above this price, and although only small tonnages have been going to the stockpile in recent months, the government's withdrawal from the market would almost certainly be enough to halt any price rise.

TIN.—Tin prices were affected early in the week by the dock strike in New York, with buyers taking up practically all the tin in warehouses. Now that the strike is over a reaction will no doubt set in.

ZINC.—The U.S. zinc market is reported to have been only moderately firm since the $\frac{1}{2}$ c. price rise on September 6. The general outlook, however, remains good, with smelters' stocks at the end of August standing at their lowest for some years at 46,087 s.tons while August domestic shipments totalled 87,042 s.tons, nearly 30,000 tons more than in the corresponding month a year ago, and bringing the total shipments for the year to date to 658,284 s.tons compared with 497,433 s.tons a year ago.

ALUMINIUM.—When negotiations now in the process of being finalized between Reynolds Metals Company and the Aluminum Rolling Mills Company (which is 75 per cent controlled by the Simard interests of Sorel, Quebec) is completed the deal will mark the first entry into Canada by one of the major U.S. aluminium companies. It is understood, however, that Reynolds Metals has no immediate plans to produce primary aluminium.

The British Aluminium Company is believed to be seeking in Canada a low-cost hydro-electric power site for the production of primary aluminium. British Aluminium, which has enjoyed a substantial market in the Dominion for several years for semi-fabricated aluminium products, is understood to be negotiating with a private power company in Quebec for capacity of some 100,000 h.p.

Meanwhile, the Aluminium Company of Canada is reported to be about to undertake preliminary construction work at Isle Maligne, Quebec, to allow for the expansion of its smelter at short notice. The growing interest in siting aluminium plants in Canada arises from the availability of cheap hydro-electric power, and this, combined with the growing world demand for aluminium and the increasing price of copper, nickel and other competitive metals, are relevant factors behind a trend which could easily result in Canada becoming the world's leading producer in the not-too-distant future.

Mr. Arthur Flemming, director of O.D.M., has announced that part of the fourth quarter U.S. Government aluminium purchases would be diverted to Britain. Mr. Flemming stated that this had been done in return for the aluminium delivered by the U.K. to the U.S.A. during the previous period of aluminium shortage in 1952-53. The total amount available to the U.K. under this agreement will be 11,000 s.tons.

In making this announcement the O.D.M. director said that he was setting aside 75 per cent of the scheduled fourth quarter aluminium deliveries to the national stockpile for the use of private industry. In this connection he planned to call upon domestic aluminium metal producers to deliver up to 100,000 s.tons in the fourth quarter. But, he added, to alleviate the serious shortage of aluminium he would defer until a later date the delivery to the government of all but 25,000 tons of the metal in the last three months of this year. This would be in addition to the 175,000 s.tons already deferred from stockpile deliveries earlier this year.

The Greek Ministry of Commerce have approved the export of 20,000 tons of bauxite to the Soviet Union. Shipments, to be carried out by the Parnassus Bauxite Company, will be made from Itea Harbour and payment will be arranged through Greek-Soviet clearing agents.

Plans are in hand to expand production of aluminium at the State-owned plant at Ardal, West Norway, from its present output of 24,000 tons per annum to 60,000 tons per annum. The Norwegian Ministry of Industry has also announced that this proposal would require a capital investment of between £15,000,000—£20,000,000.

West Germany produced 90,700 tons of virgin aluminium in the first eight months of the current year against 84,200 tons in the comparable period a year ago.

Production for the current year is estimated at 137,000 tons. Secondary aluminium output is expected to reach 80,000 tons so that domestic consumers will dispose of 220,000 tons of home-produced aluminium for the year. However, this will not be enough to cover domestic consumption and exports must, necessarily, be in the neighbourhood of 40,000 tons.

ANTIMONY.—The New York market for foreign antimony has been firmer than of late, chiefly owing to the steady de-

mand from battery manufacturers and the alloy trade. Despite the fact that demand is still not as high as at the beginning of the month, the market for lower grade metal is very brisk, with high-grade supplies tight.

GOLD.—Total declared gold output of member mines of the Transvaal and Orange Free State Chamber of Mines during the month of August totalled 1,226,557 oz. This figure includes mines which produced gold only and those which yield both gold and uranium. Production from non-member mines was 41,403 oz. The total number of natives employed in the gold mines during August totalled 313,721 compared with 320,610 in July.

NICKEL.—Further confirmation of the current nickel shortage comes from the Sudbury, Ontario, producer, Falconbridge Nickel, whose half-yearly report states that the company was unable to satisfy the requirements of its customers in the first half of 1955, although the production of refined metals was higher by 20 per cent and the output of nickel in matte form at the smelter improved by 6 per cent.

QUICKSILVER.—Although the price of quicksilver has been on the decline almost without interruption since about April last, a decidedly firmer tendency has lately been displayed. Part of the explanation for the recent weakness can be attributed to industry drawing on stocks, which are now at their lowest levels for at least 15 years. That industrialists were prepared to run down their stocks stemmed from the belief that they could be replaced at lower prices. This decision appears to have been the right one so far and may well be confirmed as U.S. mine production is steadily increasing and rose by as much as 21 per cent in the three months April-May-June this year when the total yield was 4,900 flasks. On the other hand, industrial consumption continues at a high level, a feature which the U.S. Bureau of Mines said was due to the effect of putting into operation the remaining cells in the new chlorine and caustic soda plant at Muscle Shoals, Alabama.

TITANIUM.—Titanium will be employed extensively in the Bristol Proteus 755 turboprop engines which power the long-range Bristol Britannia airliners. Titanium will be used to replace stainless steel as it is 42 per cent lighter whilst possessing equivalent properties in addition to its outstanding resistance to corrosion. The largest units to be fabricated in titanium will be jet pipe shrouds; other components to be manufactured in the metal include the inner cowl skin, the turbine shroud and the rear fire wall on the plenum chamber. The Bristol Aircraft Company estimate that the total weight saving will be about 560 lb. for each aircraft.

We are not in a position to state that the use of titanium in the Bristol Proteus 755 indicates that a big technological advance has been made in the fabrication of the metal. But it most certainly appears that this is so as the United States is still experiencing great difficulty in making use of the metal commercially.

Indeed, a report from New York this week informs that the O.D.M. has suspended indefinitely the U.S. Government's programme to encourage the building of additional facilities for the production of titanium sponge. This reflects the general opinion that until the present problems associated with working the metal are overcome it would be wrong to proceed with plans for the expansion of production facilities. The immediate explanation for this decision results from a study which has shown that present government contracts would yield more of the metal than would likely to be required for at least the next two years. In this context the Dupont Company has returned to the government a certificate of necessity granting it a tax write-off on a \$40,000,000 titanium plant near Johnsonville, Tennessee, which has now been cancelled.

U.S. titanium production this year is expected to be about 8,000 tons and it is hoped to expand output to 22,500 tons a year by the end of 1956.

The London Metal Market

(From Our Metal Exchange Correspondent)

The copper market became unsettled at the end of last week by the report that the U.S. President was being pressed to release 100,000 tons of Chilean copper from the stockpile, this copper having been acquired some while ago to help the Chilean economy. Trade circles in America point out that this would require legislation for which, as Congress is not sitting, a special meeting would have to be convened.

In the London market early this week some heavy sales of "cash" copper were made and the market fell away sharply

on Tuesday morning, but there was quite a brisk recovery later that day. It is reported from America that there are persistent rumours that the domestic price will be advanced to 46 c. per lb. in view of the dissatisfaction of Chile with the 43 c. they are getting for about 30 per cent of their output sold there compared with the very much higher prices they obtain in the world markets. In the meantime customs smelters now quote 50 c. per lb. For scrap copper American refiners seem willing to pay around 43 c. to 44 c. per lb.

Tin both in the London and Eastern markets keeps very steady, the threatened strike at the Eastern Smelting Company's works at Penang no doubt being a contributory factor. On Thursday morning the Eastern price was equivalent to £762½ per ton c.i.f. Europe.

The lead market continues firm with consumer demand good generally. In Europe arrivals and demand seem to be in balance.

The zinc market has a firm appearance, and it would not be surprising if a further moderate advance were to occur in the London market. Demand by consumers continues quite good, and in America producers' stocks at the end of August were the lowest seen for several years.

Closing prices and turnovers are given in the following table:—

	September 8		September 15	
	Buyers	Sellers	Buyers	Sellers
Copper				
Cash	£393½	£394	£382½	£382½
Three months	£388	£388½	£377½	£378
Settlement		£394		£382½
Week's turnover		3,400 tons		5,300 tons
Tin				
Cash	£744	£744½	£747½	£748
Three months	£744½	£745	£748	£748½
Settlement		£744½		£748
Week's turnover		805 tons		620 tons
Lead				
Current half month	£107	£107½	£107½	£107½
Three months	£107	£107½	£107½	£107½
Week's turnover		1,600 tons		3,200 tons
Zinc				
Current half month	£92½	£92½	£92½	£92½
Three months	£91½	£91½	£91½	£92
Week's turnover		3,450 tons		3,950 tons

OTHER LONDON PRICES — SEPTEMBER 15

METALS

Aluminium, 99.5%, £171 per ton	Nickel, 99.5% (home trade) £519 per ton
Antimony—	Osmium, £24/27 oz. nom.
English (99%) delivered, 10 cwt. and over £210 per ton	Osmiridium, £40 oz. nom.
Crude (70%) £200 per ton	Palladium, £7 0s./£7 10s. oz.
Ore (60% basis) 23s. 6d./24s. 6d. nom. per unit, c.i.f.	Platinum U.K. and Empire Refined £29 oz. Imported £32 10s. oz.
Bismuth (min. 1 ton lots) 16s. lb. nom.	Rhodium, £40
Cadmium 11s. 6d.	Ruthenium, £17 oz.
Chromium, 6s. 11d./7s. 4d. lb.	Quicksilver, £92/£94 15s. ex-warehouse
Cobalt, 21s. lb.	Selenium, 72s. nom. per lb.
Gold, 251s. 1d.	Silver, 79½d. f.o.z. spot and 79½d. f'd
Iridium, £30 oz. nom.	Tellurium, 16s. lb.
Manganese Metal (96%-98%) £269 according to quantity	
Magnesium, 2s. 4d. lb.	

ORES, ALLOYS, ETC.

Bismuth	40% 6s. 3d. c.i.f.
	60% 8s. 3d. lb. c.i.f.
Chrome Ore—	
Rhodesian Metallurgical (semi-friable) 48% ..	£13 per ton c.i.f.
" Refractory 45% ..	£13 per ton c.i.f.
" Smalls 42% ..	£10 2s. 6d. per ton c.i.f.
Magnesite, ground calcined ..	£26-£27 d/d
Magnesite, Raw ..	£10-£11 d/d
Molybdenite (85% basis) ..	105s. 0d.-108s. 0d. per unit c.i.f.
Wolfram and Scheelite (65%) ..	270s./275s. c.i.f.
Tungsten Metal Powder (98% Min. W.) ..	21s. 2d. nom. per lb. (home)
Ferro-tungsten (80%-85%) ..	18s. 2d. nom. per lb. (home)
Carbide, 4-cwt. lots ..	£39 3s. 9d. d/d per ton
Ferro-manganese, home ..	£54 10s. 0d. per ton
Manganese Ore Indian c.i.f. Europe (46%-48%) basis 100s. freight ..	84d. per unit c.i.f.
Manganese Ore (38%-40%) ..	69d. per unit
Brass Wire ..	3s. 6½d. per lb. basis
Brass Tubes, solid drawn ..	2s. 11d. per lb. basis

COMPANY NEWS AND VIEWS

Anglo American to Exploit Mrima Hill

The Anglo American Prospecting Company (Africa), registered in Kenya and a wholly owned subsidiary of Anglo American Corporation, has been awarded an exclusive licence to carry out mining investigations in Kenya, according to the Nairobi correspondent of the *Financial Times*. The license, obtained in the face of competing tenders by six of the world's leading mining companies, will enable Anglo American Corporation Prospecting to go ahead with the exploitation of Mrima Hill, which is located only 12 miles from the deep water harbour of Shimon.

Mrima Hill is estimated to contain some 30,000,000 tons of rare earths and radio-active minerals and while the mineral dressing problems connected with their separation may prove to be difficult; they are not insuperable. In fact Kenya geologists have intimated as much and what gives point to these "on-the-spot" remarks is that they were made after ore samples from Mrima had been examined by the Research Establishment at Harwell and by the U.K. atomic energy authorities.

According to the *Financial Times* the columbium content of the deposit is higher than in most other occurrences. Additionally, Mrima Hill may be the world's largest single deposit containing rare earths and radio-active minerals.

N. Rhodesia Agreement on Diamond Rights

On August 19 the Northern Rhodesia Legislative Council approved an agreement with De Beers Corporation under which diamond mining rights in Northern Rhodesia will be handed over to the Government in 1986. Diamond rights in Northern Rhodesia, along with all other mineral rights, originally belonged to the British South Africa Company, but several years ago the company handed over the diamond rights to the De Beers Corporation. The Northern Rhodesia Government has already arranged with the B.S.A. Company that all mining rights, other than diamond rights will be handed over on October 1, 1986. The Government has now concluded a similar agreement with De Beers in respect of diamond prospecting and mining rights.

Freddies Enlarges on Far West Rand Project

When the report and accounts of Free State Development and Investment Corporation were received recently, considerable attention centred around a statement contained therein which referred to a mining project on the Far West Rand. At the meeting held in Johannesburg a few days ago the project was stated to be concerned with farms Modderfontein 4, Waterpan 45 and Jachtfontein 99. The project is being organized under the aegis of Johannesburg Consolidated Investment Company but a participation amounting to 20 per cent is held by "Freddies".

A question put to the chairman of "Freddies" brought to light that the reefs in the area concerned lay at a depth between 3,000 and 6,000 ft. Some promising drilling results had been obtained from the Upper Elsburg and Ventersdorp Contact Reefs.

Klerksdorp Prospecting Operations Encouraging

Klerksdorp Consolidated Goldfields in a statement issued earlier this week has announced that the projected programme for the investigation into the potentialities of the property in Western Transvaal as a possible uranium producer is proceeding according to schedule. Prospecting operations continue to be encouraging and a further drilling programme has been instituted. It is further stated that if the outcome of the prospecting operations proves satisfactory application, in due course, will be made for the company to become an uranium producer.

Kilembe Financing

In order to complete the Kilembe Copper/Cobalt mining operation which is sponsored by Frobisher, Ltd., the United Kingdom Colonial Development Corporation, and the Uganda Development Corporation, more than \$5,000,000 is required. A recent report from Montreal intimates that this money will be made available shortly through the Toronto Investment House, Gairdner and Co., who will offer \$5,000,000 in 54 per

cent 10 Collateral Trust debentures of Kilembe Copper Cobalt which is the largest shareholder in the operating company, Kilembe Mines. Each \$1,000 of debentures will carry warrants for the purchase of 150 shares of Common stock at \$3 per share up to September 1, 1960. It is also believed that an offer of 250,000 Common shares at \$3 per share will be made.

Bremang Makes Loss in 1954

During the year ended December 31, 1954, Bremang Gold Dredging Company, the Gold Coast property, made considerable progress with implementing the plan under which all its four dredges will eventually be transferred from the Ankobra River to the Extended Areas (Offin River).

In such a period of transition—the No. 1 dredge remained out of commission for the whole year while No. 2 did not re-start working gold-bearing ground until April—it was no mean effort that the company managed to dredge a total of 6,334,880 cu. yds. of ground as compared with 6,452,100 during the preceding year and to recover 32,020 oz. of gold as against 33,701 oz.

Unfortunately, however, despite this achievement, several factors combined to bring about a net loss of £7,130 as compared with a profit of £88,581. Foremost amongst these was the rise in mine expenditure to £323,860 from £271,469 mainly due to increased costs of labour and raw materials. A fall in the average price received for gold to £12 9s. 11d. per oz. from £12 18s. 5d. was also a serious blow to the company.

On the other hand, in this statement to shareholders Maj.-General W. W. Richards, the chairman, gives some heartening news regarding Bremang's current operations. During the first six months of the present financial year operating profits earned by all four dredges together—two on the Extended Areas and two at Ankobra—have reached £47,000. During this period 4,161,680 yds. were treated producing 19,633 f.o.z. of gold. June, General Richards said, was a record month during which 4,772 oz. were recovered for an operating profit of £22,689. Similar improved results were expected in future months.

Although the eventual transfer of Bremang's two remaining dredges to the new areas will call for considerable expenditure in the future, it is encouraging to hear that this next phase will not be considered until Nos. 1 and 2 dredges have continued to yield—over a period—satisfactory returns and profits. At that point the question of providing additional capital by an offer of shares to finance this programme will be reviewed. Until this step has been reached, temporary arrangements will be continued.

Amalgamated Tin Pays One Per Cent More

With the declaration of a third interim dividend of 25 per cent on the issued ordinary capital of £1,950,000, total distribution by Amalgamated Tin Mines of Nigeria for the year ended March 31, 1955, has been raised to 45 per cent from the previous total of 44 per cent.

The company is Nigeria's biggest producer of both tin and columbite.

<i>Year to Mar. 31</i>	<i>Total Profit*</i>	<i>Taxa- tion</i>	<i>Net Profit</i>	<i>Dividends</i>		<i>Carry Forward</i>
	£	£	£	£	%	£
1955	1,484,069	768,000	502,069†	494,812	45	274,459
1954	1,497,506	926,000	496,506‡	471,900	44	267,202

* Including 100 per cent dividend from Keffi Tin Co. of £77,061 gross.

† After additional depreciation of £385,000 less transfer of £200,000 from Contingencies Reserve. Profit figure also takes account of £29,000 additional taxation debit.

‡ After £75,000 transferred to Contingencies Reserve.

At their present price of around 13s. Amalgamated Tin's 5s. shares return over 16½ per cent.

Estimate of "Life" of Tronoh Mines

Shareholders in Tronoh Mines were given an estimate of the "lives" of the areas remaining to the company's dredges by Mr. J. H. Rich, in his address to shareholders at the annual meeting held in London to-day. Assuming normal continuous running, the chairman estimates that the areas remaining to the dredges will last No. 1 dredge for 17 years while for the three dredges Nos. four, five and eight—the ground to be worked will last for 84 years.

The company's new treatment plant has not only improved the recovery of tin from the amang but it has also made practical the separation of monazite and other rare earths for which there is an expanding market.

Two other points of interest in Mr. Rich's address concerned Tromal Prospecting Ltd., and Harrierville (Tronoh), Ltd. With regard to Harrierville, its dredge has now been sold—presumably to Ayer Hitam—and it is anticipated that Tronoh Mines' loan to Harrierville amounting to £53,500 will be repaid in full, and there may also be a small return on the company's shareholding in the undertaking. Referring to Tromal Prospecting the chairman said it was anticipated that production using a grab dredge will begin about the middle of 1956.

British Burmah Petroleum in 1954-55

As it was in April last—after the close of British Burmah Petroleum company's financial year on March 31, that the Burma Oil Company (1954) declared its maiden dividend, the proceeds of this distribution could not be taken into the company's accounts.

Year to Mar. 31	Total Revenue £	Exp- ences £	Tax- ation £	Net Profit £	Divi- dend £	Carry Forward* £
1955	75,374	30,198	8,459	36,717	37,500	78,709
1954	86,479	33,019	6,002	47,458	37,500	104,479†

* After provision for diminution in investment values £25,000 (1954 - £150,000).

† After deducting £11,213 in respect of emigration expenses and amounts written off.

Referring to British Petroleum's South African subsidiary, Mr. A. P. Faickney, the chairman, stated that this company had earned improved profits during the past financial year.

Meeting Johannesburg, September 30.

G.M.K. and New Coolgardie Gold Merger

Gold Mines of Kalgoorlie (Australia) has offered to acquire the entire undertaking of New Coolgardie Gold Mines N.L. The offer takes the form of an allotment to New Coolgardie of 286,272 fully paid shares in G.M.K. which would be equivalent to 28 G.M.K. shares for every 100 shares of New Coolgardie.

Western Mining Corporation (which has a direct holding of 52 per cent of the issued capital of New Coolgardie and a 25 per cent direct holding in Gold Mines of Kalgoorlie) in making this announcement stated that the offer was under consideration by the directors and that a further announcement could be expected shortly.

Morning Star (G.M.A.) Mines Share Offer

To ensure sufficient funds to complete and equip the shaft and to develop the lower levels of the mine, Morning Star (G.M.A.) Mines N.L. will offer 500,000 shares of A4s. each at par to shareholders in the ratio of one-for-one. The sum of 6d. will be payable on acceptance and on calls as necessary but these will be kept to the minimum required to complete the programme.

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FREE STATE DEVELOPMENT AND INVESTMENT CORPORATION LIMITED

(Incorporated in the Union of South Africa)

Extract from the chairman's speech at the annual general meeting, held in Johannesburg on September 6, 1955.

It is unlikely that drilling operations will be undertaken by your company in the near future, and, as mentioned by the chairman at the last annual general meeting, the services of your company's employees have been dispensed with and most of the stores, materials and drilling equipment have been sold.

The areas over which your company owns rights in the Orange Free State are set out in detail in the directors' report and in the plan which accompanies it. There has been no material change in the rights held and they remain virtually the same as they were at the end of the previous year. These rights are being retained by your company and will be turned to account if and when opportunity occurs, although at present there are no negotiations in progress with a view to incorporating any of these areas into mining leases or otherwise disposing of them.

As indicated in the directors' report, since the close of the financial year your company has accepted a participation in a prospect which is being conducted on the Far West Rand by the Johannesburg Consolidated Investment Company Limited. In terms of the arrangements which have been entered into, your company is bearing 20 per cent of the expense of the prospect and will be entitled to 20 per cent of the net rights which may flow from it.

The prospect is being conducted on the farms Modderfontein No. 4, Waterpan 45 and Jachtfontein 99, its centre being situated about 18 miles due south of the town of Randfontein.

Some promising results have been obtained from the upper Elsburg and Ventersdorp contact reefs in boreholes drilled in this area, but a somewhat complicated geological problem is involved and a considerable amount of work remains to be done before any reliable estimate can be formed as to whether the area is likely to prove to be of economic significance. In these circumstances interim results might well be misleading and, by agreement among the parties concerned, will not therefore be published.

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GEEVOR TIN MINES LTD.

The forty-second annual general meeting of Geevor Tin Mines, Ltd., was held on September 14 in London.

Mr. G. W. Simms (the chairman) presided, and the following is an extract from his statement for the year ended March 31, 1955:—

As a result of the sale of the greater part of the Company's accumulation of flotation residues, the operating profit amounted to £109,706, compared with £53,074 profit in the previous financial year. The Directors recommend the payment of a final dividend of 1s. 6d. per stock unit, which, with the interim dividend of 9d. per unit, will make a total distribution for the year of 2s. 3d. per stock unit, less income tax.

The long term outlook for tin is, I believe, good, as the trend of world consumption is upward while the trend of production in the more important tin producing countries is likely to be downward in the relatively near future.

It is natural to ask why the Cornish Tin Industry remains practically static with an almost negligible production having regard to the total quantity of tin consumed in this country! The answer to this is, of course, the almost penal nature of mine taxation in the U.K. From the strategic standpoint alone the case for Government action to ameliorate taxation so that the industry may thrive seems unanswerable. It would cost little and the altered conditions in many of the producing countries are such that common prudence suggests the advisability of taking early action to foster and develop the home industry.

CHAIRMAN'S ADDITIONAL REMARKS

During the current financial year the Company has entered into a contract to dispose of a substantial part of its remaining Flotation Residue dump, for the sum of approximately £30,000. This will increase the actual Mine profit above that which would have been derived from current mining operations only.

After the completion of this contract, a relatively small quantity of the Flotation Residue dump will remain and in future the proceeds of any such sale will fairly closely represent the revenue to be derived from current production, provided such production is saleable.

The report was adopted.

Mining Men

Mr. G. P. Belsham has been appointed sole managing director of Brookhirst Switchgear Ltd., Chester. **Mr. D. W. Kent** has been appointed sole managing director of Igran Electric Co. Ltd., Bedford. On taking up this appointment Mr. Kent will relinquish his seat on the Board of Sentinel (Shrewsbury) Ltd. **Mr. E. Bruce Ball, C.B.E.**, has joined the Boards of Sentinel (Shrewsbury) Ltd., Fawcett, Preston and Co., Ltd., Finney Presses Ltd. and Ferrous Castings Ltd.

All of the companies mentioned above are members of the Metal Industries Group of Companies. **Mr. E. Bruce Ball** has been appointed an additional director of Metal Industries Ltd., Universal House, 60 Buckingham Palace Road, London, S.W.1.

Mr. R. B. Hagart has been appointed a director of African Explosives and Chemical Industries in the place of the late Mr. P. M. Anderson.

Mr. John Q. McDonald, vice-president in charge of export Caterpillar Tractor Co., Peoria, Illinois, U.S.A., will arrive in this country about September 15 and will be present at the demonstration of the world's largest tractors, the two Caterpillar D9's, at an open-cast coal site in Yorkshire, during the third week of September. A description of the Caterpillar D9 tractor appears in the *Machinery and Equipment* notes in this issue.

The death is announced of **Mr. F. G. Penny**, managing director of International Combustion (Holdings) Ltd., chairman of Aberdare Cables (Holdings) Ltd., and a director of many other companies. This announcement is followed by the report that **Mr. Vernon Young** has been appointed chairman of International Combustion Ltd. **Mr. Walter Grainger** and **Mr. John Mayer**, who were recently appointed joint managing directors of International Combustion (Holdings) Ltd., have also been appointed as joint managing directors of International Combustion Ltd.

Dr. B. D. Thomas, **Mr. David C. Minton, Jr.**, and **Mr. John S. Crout** have been appointed vice-presidents of the Battelle Institute, Columbus, Ohio.



Spanning the East

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Mining Matters

The I.M.M. and I.M.E. Joint Library Facilities. The Institution of Mining and Metallurgy and the Institution of Mining Engineers are moving into separate headquarters and dividing the present joint library.

The Institution of Mining and Metallurgy has already moved and all correspondence, gifts, subscription publications and exchanges should now be sent to The Librarian, The Institution of Mining and Metallurgy, 44 Portland Place, London, W.1. Telephone: LAN 3802-3-4.

Subjects covered by the I.M.M. Library will be economic geology, mining and mineral dressing of all minerals except coal, and extraction metallurgy of all metals except iron.

The Institution of Mining Engineers from October 1 will be at its new address and therefore all correspondence, gifts, subscription publications and exchanges should be sent to Miss P. Parker, Librarian, The Institution of Mining Engineers, 3 Grosvenor Crescent, London, S.W.1.

Subjects covered by the I.M.E. Library will be geology and the mining of coal and other stratified deposits, the processing of coal and allied industries.

Birlec's New Melting Furnace Development. Birlec, a member of the A.E.I. Group, has reached an agreement with Otto Junker G.m.b.H., of Lammersdorf, Germany, and the Ajax Engineering Corporation of Trenton, New Jersey, U.S.A., for the development and marketing of the main frequency coreless induction melting furnace.

This type of furnace is widely applicable to both ferrous and non-ferrous melting, including light metals and alloys, and has been pioneered over a number of years in Germany by Junker, who have made over 80 installations, totalling some 30,000 kW. More recently, in England, Birlec began development work in the same field and has a prototype unit in industrial use. By pooling the technical resources and experience of these three well-known companies in the induction furnace field, a valuable contribution to melting practice becomes available to the metallurgical industries throughout the world.

Hewitt-Robins to Build Giant Conveyor for Kitimat. Hewitt-Robins, Inc., has received an order for a three-mile conveyor system to move sand and gravel required in the building of a new addition to the Aluminium Company of Canada plant at Kitimat, British Columbia.

The system will consist of 14 conveyors, each 800 to 1,500 ft. long, linked together to provide continuous movement of the material from a sand and gravel hill to the plant site.

Some of the equipment will be shipped from Hewitt-Robins plants in the United States and some from the plants of Hewitt-Robins affiliates in Canada.

Igran's Electric Coal Ltd., have announced that Alan Colless Pty., Ltd., have appointed Clark-Strickland Pty., Ltd., 17 McKillop Street, Melbourne, C.1., Victoria, Australia, to act as their agents for Igran's motor control gear throughout the State of Victoria.

Martin-Black's Trading Contact With Far East. Martin, Black and Co. (Wire Ropes) Ltd., of Lanarkshire, have recently established trading contacts in Japan, and supplies of wire rope are now being shipped to that country from their Coatbridge factory. The orders were placed with Martin-Black's distributors in New York, and payment is being made in dollars.

New Zealand Orders Bagnall Diesel Locos. W. G. Bagnall of Stafford (a subsidiary of the Heenan Group) has received a further order from the New Zealand Government Railways for the supply of seven 0-4-0 diesel-mechanical shunting locomotives. Two of the locomotives will be powered with Gardner 6L3 engines and the remainder with McLaren M6 engines. The nominal h.p. will be 150 and the weight in working order will be 20 tons. The previous contract received from New Zealand was for ten 240 h.p. 0-6-0 diesel shunters powered by National M4AA6 engines which are now under construction at the Castle Engine Works.

W. G. Bagnall have also recently received an order from the National Coal Board for two diesel mechanical shunting locomotives for use at the new Lea Hall Pit, near Rugeley in the Cannock Chase Area. The locomotives will be powered by National M4AA5 diesel engines developing 220 h.p. at 1,500 r.p.m. and are of the 0-6-0 type suitable for 4 ft. 8½ in. gauge track. These locomotives weigh 28 tons in working order and are capable of hauling trains of 1,000 tons gross weight on the level. This means that in one year W. G. Bagnall will have been engaged in the production of N.C.B. locomotives with three entirely different types of motive power. An article describing the use of Bagnall locomotives in the mining industry appeared in last week's issue.

MILL SUPERINTENDENT. Qualified man required for large Tin and Wolfram property in BURMA. Commencing salary and allowances £136 per month, plus free living quarters, medical attention, accident insurance and other benefits. Three year contract. Write, stating age, experience, etc., to Box M.J. 976, c/o 191 Gresham House, E.C.2.

Experienced SHAFT SINKER wanted for established Mining Company in Portugal. Guaranteed minimum 12 months' contract. Good salary. Passages, furnished quarters, lighting and medical attendance free. Excellent climatic conditions. Suitable applicants will be interviewed in London. Reply Apartado 884, Lisbon, Portugal.

CHIEF ENGINEER. Qualified man required for British-owned Tin and Wolfram Mines in BURMA. Salary and allowances £150 a month plus free quarters, medical attention, accident insurance and other benefits. Write, stating age, experience, etc., to Box M.J. 101, c/o 191 Gresham House, E.C.2.

METALLURGICAL ASSISTANT required by Copper Mining Company. Applicant should be European and should hold a recognized metallurgical degree. Starting salary dependent on qualifications and experience, with minimum £675 per annum plus cost-of-living and servant allowances of £140 per annum. Variable annual bonus paid (last year 35 per cent of basic salaries) and Provident Fund in operation. Three years' contract with leave on full pay after 2½ years at the Works. Free furnished accommodation with fuel and light. Apply, giving full particulars to Box 765, Walter Skinner Ltd., 20 Copthall Avenue, London, E.C.2.

GOLD COAST GOVERNMENT

Applications are invited for vacancies in the post of GEOLOGIST in the Geological Survey Department. Duties: Geological mapping and the application of geological and geophysical methods to water supply and engineering problems.

Qualifications: First-class Honours or Second-class Honours, Division I, degree in Geology.

Terms of Service: These posts are "Development Posts" for implementation of specific projects under the Gold Coast Development Plan. The appointments will be on contract/gratuity terms for three tours of 18 to 24 months each. Salary will be on an incremental basis in the range of £1,030 x £50—£1,530, £1,600 x £60—£2,020 per annum (consolidated), according to age, qualifications and experience. A gratuity at the rate of £37 10s. for each completed three months of satisfactory service will be payable on final termination of the contract.

Other Conditions of Service: (i) Work will be in the field and geologists may be expected to live under camping conditions under canvas in the first instance, but steps are being taken to construct temporary weather-proof prefabricated housing which officers will be able to use as their base and to return to for periods from time to time as working circumstances permit, on payment of a rental of £30 to £60 per annum, according to salary.

(ii) A geologist may not be accompanied by his wife and family on first assumption of duty in the Gold Coast, but they may be allowed to join him later.

(iii) Free passages on first appointment and on leave will be provided for the officer and his wife once each way during each tour of service. Officers will normally be required to travel by air. Free air passages will also be provided for a maximum of three children under 13 years of age.

(iv) Vacation leave with pay at the rate of seven days for each completed month of service. Income tax at local rates. Kit allowance on first appointment, £60-£30, according to initial salary if no recent tropical service.

Intending candidates should apply for a form of application to The Adviser on Recruitment, Gold Coast Office, 13 Belgrave Square, London, S.W.1.

MINE RETURNS

AUSTRALIAN GOLD

Company	4 weeks to July 12 1955		4 weekly period since year-end	Current Financial Year Total to date		Last Financial Year Total to date	
	Tons (000)	Yield (oz.)		Tons (000)	Yield (oz.)	Tons (000)	Yield (oz.)
Central Norseman	12.4	7,817	4	49.5	28,423	48.4	26,970
Central Victoria*	90.9	282	4	350.2	1,322	823.6	2,042
G.M.'s of Kalgoorlie	37.7	8,901	4	148.4	35,039	—†	—
Great Western Cons.	28.7	3,326	4	121.6	17,637	133.7	14,998
Morning Star	1.3	328	4	5.5	1,941	5.5	4,158
New Coolgardie	5.0	2,366	4	19.2	8,609	18.8	9,299
North Kalgoorlie	28.1	6,045	7	183.8	39,216	124.1	30,853
Sons of Gwalia	10.0	1,624	7	65.1	13,075	54.5	12,247

* Cu. yds. dredged.

† Last year's figure not comparable.

WEST AFRICAN GOLD

Company	July, 1955			Months since year-end	Current Financial Year Total to date			Last Financial Year Total to date		
	Tons (000)	Yield (oz.)	Profit (£000)		Tons (000)	Yield (oz.)	Profit (£000)	Tons (000)	Yield (oz.)	Profit (£000)
Amal Banket	75.8	12,882	29.0	10	805.6	125,900	311.7	689.2	109,586	155.9
Ariston Gold	38.8	11,348	48.8	10	275.7	88,947	475.6	328.3	106,762	489.2
Ashanti	26.5	16,230	67.6	10	251.5	162,936	698.3	246.5	158,119	647.4
Ibibi (1927)	30.0	6,250	10.2	10	299.0	63,100	125.9	303.0	63,555	99.5
Brumang*	888.8	4,195	19.0	7	5050.5	22,850	65.6	3241.2	14,286	0.6
G.C.M. Reef	8.6	3,117	7.4	1	8.6	3,117	7.4	10.0	3,958	12.4
Konongo	3.5	3,122	15.1	10	34.2	31,572	156.0	28.0	28,515	136.2
Lyndhurst Dp	1.0	1,013	5.2	10	10.1	11,241	58.0	10.2	11,693	56.3
Taqua & Ab.	27.5	5,957	2.9	4	113.5	23,165	8.7	108.4	23,518	15.4

* Dredged in cu. yds. Profit figures include premium revenue.

SOUTHERN RHODESIAN GOLD

Company	July 1955			Months since year-end	Current Financial Year Total to date			Last Financial Year Total to date		
	Tons (000)	Yield (oz.)	Profit (£000)		Tons (000)	Yield (oz.)	Profit (£000)	Tons (000)	Yield (oz.)	Profit (£000)
Arcturus	3.1	1,077	3.4	1	3.1	1,077	3.4	2.9	905	2.9
Cam & Motor	24.0	7,569	41.5	1	24.0	7,569	41.5	24.5	7,723	45.3
Falcon Mines	18.0	3,205	2.1	10	174.3	31,504	101.0	168.9	28,042	87.2
Globe & Phoenix	6.1	3,587	22.9	7	42.4	24,780	164.0	42.4	25,287	163.6
Motapa Gold*	16.5	2,310	2.3	7	111.0	15,599	5.7	128.5	17,515	23.8
Muriel Mine	3.1	1,119	10.0	1	3.1	1,119	10.0	3.1	994	10.1
Tebekwe	6.3	888	1.1	1	6.3	888	1.1	8.0	982	1.6

* Excluding premium gold sales. L indicates a loss.

INDIAN GOLD

Company	July 1955		Months since year-end	Current Financial Year Total to date		Last Financial Year Total to date	
	Tons (000)	Yield (oz.)		Tons (000)	Yield (oz.)	Tons (000)	Yield (oz.)
Champion Reef	15.7	5,767	7	104.3	37,135	103.8	39,601
Mysore	18.5	5,763	7	113.4	35,681	124.4	47,437
Nundydroog*	21.8	6,399*	7	128.3	39,243	150.2	43,172

* Includes tailings.

MISCELLANEOUS GOLD RETURNS

Company	July 1955		Months since year-end	Current Financial Year Total to date		Last Financial Year Total to date	
	Tons (000)	Yield (oz.)		Tons (000)	Yield (oz.)	Tons (000)	Yield (oz.)
Br. Gv. Consol*	192.3	1,433	7	1192.7	9,911	1362.1	11,823
Clutha River*	253.0	486	4	949.0	1,826	979.0	1,389
Frontino	12.3	6,065	7	82.2	42,390	72.2	40,588
Kentana (Geita)	23,500	3,407	1	23,500	3,407	22.0	3,420
St. John d'El Rey	28.8	128.0	7	173.2	746.3	180.9	825.1

* Cu. yds. dredged.

OIL OUTPUT

Company	July (in tons)	Months since Year End	Cumulative Totals (in tons)	
			This year to date	Last year to date
Anglo Ecuadorian	28,206	4	108,369	108,313
Apex Trinidad	17,589	10	373,618	372,794
Kern Oilfields	26,189	2	52,701	53,513
Kuwait Oil	4,824,665	7	31,948,222	26,043,445
Lobitos Oil	45,425	7	306,996	289,131
Trinidad Central	8,225	7	57,638	61,942
Trinidad Leaseholds	77,271	1	77,271	78,949
Trinidad Petroleum	41,690	12	490,619	474,555
Ultramar Oil†	108,162	7	750,548	747,155

Note—1 ton taken to equal seven barrels.

† Output figures are for S.A.P. Las Mercedes in which Ultramar holds a 50 per cent interest.

COAL OUTPUT

Company	July (in tons)	Months Since Year End	Cumulative Totals (in tons)	
			This year to date	Last year to date
Amal. Coll. of S.A.	577,449	7	4,040,490	4,032,595
Apex	85,307	7	596,162	560,435
Blesbok	44,307	7	301,488	316,679
Coronation	81,595	7	634,130	605,263
Natal Navigation	104,968	1	104,968	109,617
New Clydesdale	70,503	1	70,503	64,848
New Largo	99,238	7	628,491	557,007
S.A. Coal Est.	134,214	1	134,214	136,437
Springbok	69,494	7	498,785	480,409
Transvaal & Delagoa	113,006	11	1,440,606	1,297,178
Van Dyks Drift	50,319	7	411,263	337,721
Vierfontein	111,449	7	756,907	519,563
Vryheid Cor.	49,375	7	321,698	292,474
Vryheid Cor.*	42,046	7	270,044	246,258
Wankie Coll.	270,593	11	2,984,239	2,233,894
Wankie Coll.*	13,478	11	181,327	129,553
Witbank	155,436	7	1,047,479	926,186

* Coke

TIN OUTPUT IN TONS OF CONCENTRATES

Company	July	Months since year-end	Financial Year to Date		Company	July	Months since year-end	Financial Year to Date	
			This	Last				This	Last
EASTERN									
Amplat	131	7	7971	6523	Bisich†	30	7	2511	139
Banjant	773	3	2493	1733	Ex. Lands	48	7	367	263
Ipo	1010	4	109	156	Gold & Base	59	7	325	175
Kamunting	1751	4	4599	3763	Gold & Base†	171	7	100	681
Kinta K.	12	4	421	943	Jantar†	25	10	204	168
Kinta T.	27	7	2134	1791	Kaduna P.	23	10	169	178
Klang River	93	4	70	1373	Jos Tin	61	7	411	421
Kramat Tin	25	4	1371	563	Kaduna S.	161	12	1411	1501
Kuala K.	1893	4	679	802	Keffi	15	7	158	179
Kuchai	652	10	5592	2664	Lond. Nig.	34	4	138	133
Larut	723	7	616	635	Naraguta Ex.	164	4	734	92
Lower Perak	1653	3	4953	5891	Naraguta K.	121	7	463	333
Malaysia	12	4	51	403	Naraguta T.	101	7	71	93
Pahang	230	12	2640	2640	Naraguta T.†	14	7	871	1151
Rahman H.	323	0	323	37	Ribon	61	7	542	48
Rantau	83	1	83	463	Ribon†	17	4	58	39
Rawang Conc.	22	4	1003	2293	S. Bukerut	21	4	61	Nil
Rawang Tin	993	4	4403	177	S. Bukerut†	4	7	383	474
Renong	773	1	773	138	Tinfields of Nig.	1	7	5	2
S. Kinta	2394	4	10903	17023	Tinfields of Nig.†	21	4	63	9
Siamese Tin	1783	7	12921	12463	U. Tin	11	4	93	93
Sungei Kinta	30	7	166	1323	U. Tin†	16	1	16	14
Taipung	611	7	406	3851		61	1	61	1
Tambah	113	7	902	1473	MISC.				
Tanjong	873	7	5531	4233	Beralat Tin	14	4	47	20
Tongkah	863	1	863	403	Beralat Tin†	158	4	651	649
					Crescor	60	4	221	217
					Sth. Croftly Tin	641	7	400	354
NIGERIA					Sth. Croftly Tin†	Nil	7	14	41
Amal. Tin	508	4	1426	1336	Tin & Assoc. Minb	203	3	421	—
Amal. Tin†	493	4	232	194	Tin & As. Min†	333	3	53	—
Bisich	663	7	482	321					

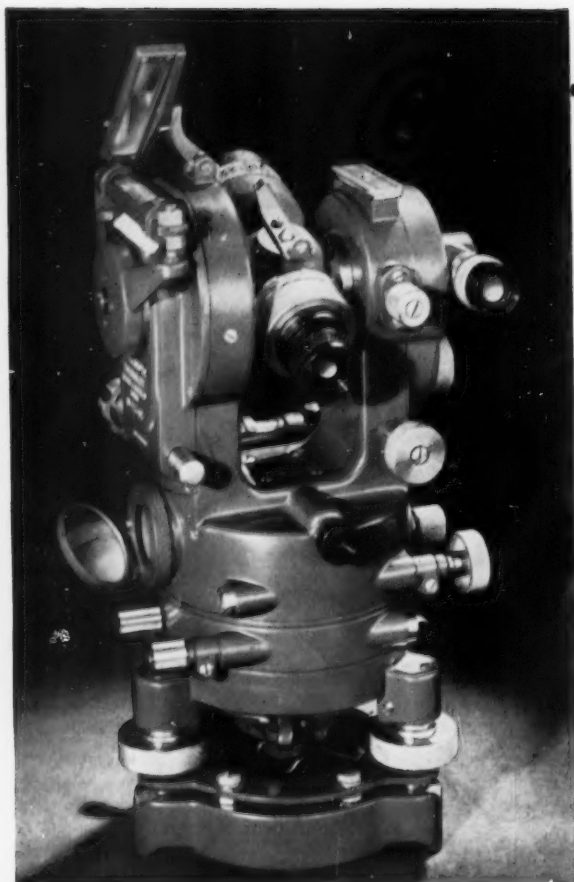
* Quarterly

† Columbite

‡ Wolfram

* Dredging ceased July 15, owing to breakdown. Expected to resume about September

† No. 1 Dredge closed July 5 for repairs.



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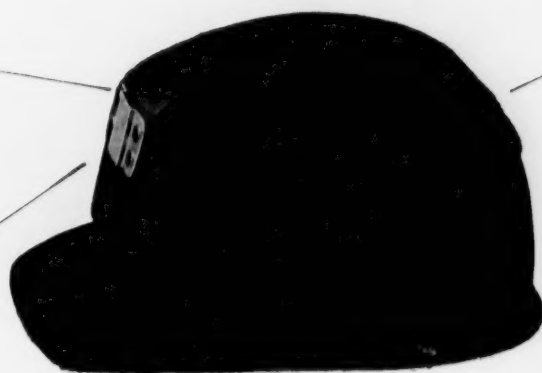
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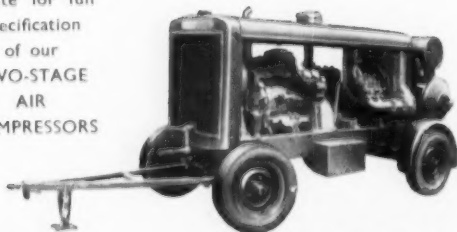
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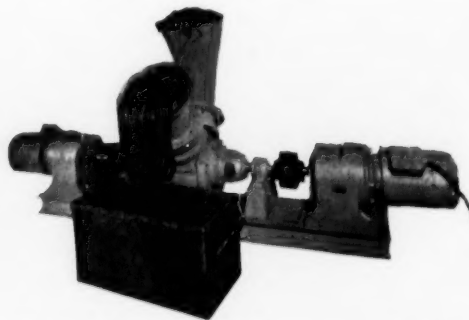
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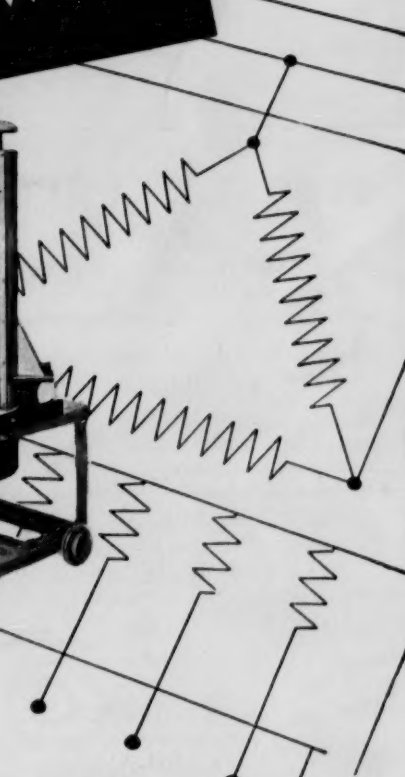
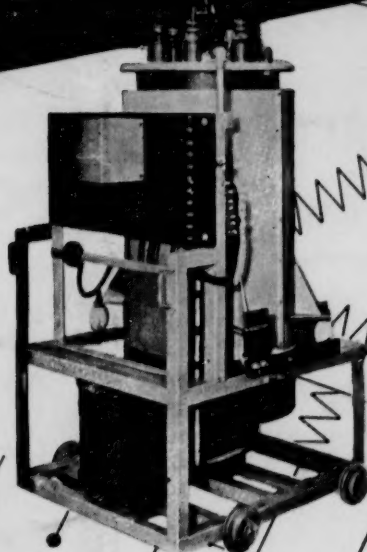
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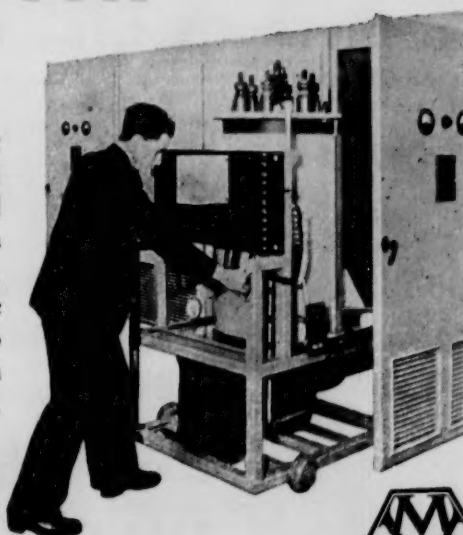
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